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Public Speaking Again

COMMENT has been made several times in these columns regarding the value to the engineer of facility as a public speaker. The appreciation of its value is growing rapidly, and at a recent meeting the San Francisco Association of Members of the American Society of Civil Engineers referred the subject to its board of management, suggesting the advisability of offering a course in public speaking for the members. The idea, as proposed in a motion, was that a competent instructor might be engaged to prepare and give a course along lines especially adapted to the requirements of engineers. It is needless to comment at length upon this suggestion. It should meet with hearty approval, and it would not be surprising if, in case the course is established, the enrollment, proportional to the membership of the association, should be very large. The suggestion may well be taken up by other associations of engineers. There are few things they can do which are likely to prove more beneficial to the members as individuals.

Galveston Repairs Storm Damage

RESOURCEFULNESS has ever been a marked characteristic of the civil engineer, and his services at Galveston after the storm have justified the confidence in his ability to think and act quickly in an emergency. Mr. Van de Greyn's account, on page 500, of how the hurricane's recent damage is being repaired makes interesting reading. When the causeway was washed away the people of the city were, in fact, marooned, for Galveston is located on an island a long distance from the mainland. The situation was grave, indeed, for the water supply pipe had been snapped in two by the waves and there was immediate need for food and emergency supplies of all sorts, which could be delivered only by the comparatively slow medium of boats. The engineers buckled down to their work, however, and in 17 hr. had water flowing through a new pipe line, laid temporarily on the causeway wreckage. In less than a week a long timber trestle had been constructed to carry railway traffic across the bay, and other repair work is being prosecuted rapidly. It appears that comprehensive plans for additional protection of the city against wind and wave are being formulated and that further work on the sea-wall, to prevent the wash from blowing inland and scouring out the area back of the wall, may be undertaken. On this matter of increasing the sea-wall's efficiency it would be well for the local authorities to give careful consideration to the recommendation made by Dr. Elmer L. Corthell in the Engineering Record of Oct. 2, page 426. He suggested that a solid parapet, in the form of a curved overhang, be anchored to the top of the wall so as to throw the wave mass seaward after it strikes the barrier. This improvement, together with the filling in of certain low-lying areas, would offer effective protection against future storms.

Practical Reasons for Lug Angles

ALTHOUGH the principle conclusion of Professor Batho, as the result of careful tests on the value of lug angles for the end connections of tension members, reported on page 512 of this issue, is that such angles are valueless and cumbersome, it should be pointed out that there are practical reasons for the use of short connection angles of this type. In many cases the joint detailing is much simplified by avoiding long, single lines of rivets in the connection plates, and the advantages in smaller gussets tend to offset the cost of using lug angles. In roof trusses, especially, where the top chord members are usually composed of one web plate and two angles, some of the web members can be connected with sufficient rivets to a comparatively narrow web plate only when lug angles are used. While it is evident from the results of the tests that no appreciable difference in uniformity of stress is produced by the lug angles, there is no reason why they should not be used whenever local conditions at the joints are improved. The compressive stresses found in the single-angle members under tensile stress impressively demonstrate the fact that a large element of bending exists in single-angle tension members connected to end gusset plates. It is worthy of note that the special form of mirror extensometer used, and described on page 514, has apparently many advantages in accuracy and facility of application in the laboratory.

Harbors in the West Indies

THE sublime faith of the inhabitants of most of the cities in the West Indies having good, or even fairly good harbors, in the belief that the full opening and utilization of the Panama Canal will give them ports of world-wide importance, increase their populations to unbelievable numbers and treble real estate values has amused more than one traveler. It was on the strength of this belief that the people of Cienfuegos, Cuba, insisted that the Government improve its harbor and that the expensive sewer system and waterworks recently constructed there were undertaken. Even backward, revolution-ridden, Port au Prince, Haiti, was stirred to activity, with the result that a splendid 2300-ft., reinforced-concrete wharf was built amid the rusting hulls of the sunken ships that were formerly the most noticeable feature of the bay. The claims of some of these cities are, without question, logical and justified to a considerable extent. Enough so, in fact, to make it seem that the engineer could render a great service in capitalizing their confidence. If faith was strong enough in Cienfuegos to result in the expenditure of several million dollars on new construction years before the Canal was completed and vital enough to make the Government of Haiti forget for the moment its antipathy to anything resembling progress and its rigid avoidance of anything that might attract Caucasians to the island, and grant a concession for a modern wharf on very liberal terms, surely it is of sufficient moment to justify the engineer in at least considering the question. A sentiment toward an intelligent and comprehensive plan of improvement, so as to be in a position to derive the full advantages their situation affords them, should be easy to arouse in most cities whose claims are justified. A good service could be rendered the others in demonstrating to them the fallacy of their beliefs.

Federal Policy a Construction Impetus

COMING from an official source, the statement that the United States Government will protect, by suitable legislation, industries developed here to supply products the importation of which has been cut off by the European war is of great importance to engineers and contractors. This announcement, by Dr. Edward Ewing Pratt, chief of the Bureau of Foreign and Domestic Commerce, made before the Society of Chemical Industry at New York Oct. 22, opens the way for capital to embark on the construction of plants for manufacturing not only dyes, but also a wide variety of other products heretofore imported, without fear that unfair foreign competition after the war will wipe the investment out. This fear has throttled such enterprises and caused a stagnation in privately-financed construction at a time when all other lines of business were beginning to show marked improvement. If there is confidence that Congress will back up this announced policy of the Administration by the necessary legislation there will be a flood of money seeking investment in many lines of industry made profitable by this action. The privately-financed construction of industrial plants that would follow the establishment of the Government's policy on this question would mean a real awakening in engineering and construction lines that have been practically dead for the past fifteen months. The Engineering Record welcomes the announcement of Doctor Pratt that "It is our desire that the United States shall have independent and self-sufficing industries," and, "I hope that the time has arrived when we can do away with our industrial crutches." Engineers and contractors are only too ready to design and build the plants and industrial centers that will accomplish this result, when capital is safeguarded in financing the projects.

Standardizing Paving Specifications

IN SUCH an important matter as the adoption of standard paving specifications by a national organization of city officials the practice of basing final action on a vote of those in attendance at a convention, as was done by the American Society of Municipal Improvements at its meeting in Dayton last week, is open to very serious objection. Such decisions, especially if they are reached during the final sessions of a long-drawn-out program, when every one is weary of listening to further discussion and many have departed on their homeward journeys—leaving a mere handful present—can not be considered as truly representing the opinion of the society at large.

It would seem that in matters affecting standards of paving practice throughout the country the final word should be said only after a canvass of the entire membership by letter ballot, after the committee report has been received. Without touching upon the desirability of making a patented bituminous pavement a standard, as was done at Dayton, it should be noted that no agreement could be reached by the sub-committee, which submitted both a majority and minority report, that the general committee, refusing to approve the majority report, submitted both reports to the convention, and that the minority report was substituted for the majority report by an exceedingly close vote, indicating very clearly that there was a decided difference of opinion even among the few members present as to the propriety of the action taken.

The argument that the men whose opinions are worth while attend such conventions and that, therefore, a vote from the floor represents the views of the best in a society loses its force under the conditions which existed at Dayton during the concluding sessions when interest lags. The remedy is shorter convention periods, terse papers with restrictions as to length of time allotted for presentation, and, in the case of such an all-inclusive organization as the American Society of Municipal Improvements, section meetings for highly specialized subjects. Mr. Folwell presented at the meeting an excellent digest and recommendations for committees, with more clearly defined limits; this is a long step in the right direction. The highly specialized work of the asphalt chemist is not of particular interest to the sewage treatment expert, but specifications based on the work of these men are of vital importance to city officials depending on the society for efficient standards. They should, therefore, be adopted only after the most careful and thorough consideration and should represent the views of the majority of the members and not those of a small group, as expressed by a vote from the convention floor at the eleventh hour.

New Eligibility Qualifications for Engineer Officers

FEW civilian engineers are acquainted with the fact that membership in one of the four national engineering organizations, civil, mining, mechanical and electrical, is held as an alternative educational qualification in the examination of candidates for commissions as officers of volunteer engineers. The announcement was made in General Order 50, 1915, of the War Department issued Aug. 25 as an amendment to General Order 54, 1914. Candidates for positions on the list of eligibles are required to appear before boards of officers of the Corps of Engineers and of the Medical Corps, U. S. A.

Following satisfactory physical and moral examination, the board questions the candidates generally as to their experience and then examines into their technical qualifications. On such evidence the board arranges candidates in order of merit and then recommends them for the grades to which they appear to be fitted. For the grade of lieutenant one must be an engineer in active practice of his profession or some business immediately connected with or concerned in engineering matters. He must either hold the grade of junior engineer, civil, electrical or mechanical, or higher grade in the civil service, be a graduate of an approved engineering college, or be a junior member of the American Society of Civil Engineers, member of the American Institute of Mining Engineers, member of the American Society of Mechanical Engineers or associate member of the American Institute of Electrical Engineers, or he must be or have been a non-commissioned officer of the grade of sergeant or higher from one of the regular battalions of engineers.

Among other alternative qualifications that of associate membership in one of the national organizations is named as necessary for the grade of captain and full membership is demanded for field officers. There are other requirements as to knowledge of military regulations for captains, and examinations are required for the grade of field officer. To become enrolled on the list for positions on the military railway staff or with railway troops candidates may submit evidence of their actual employment in corresponding positions upon a first-class railway.

Inasmuch as many engineers in and out of the national societies have signified their intention to co-operate with the War Department this order gives them an opportunity to be enrolled as lieutenants without having had military training. Undoubtedly there will soon be available a means whereby engineers too busy to attend training camps can obtain at least a correspondence course of instruction in field service and army regulations. This would enable one qualified by education and civil experience to be listed as a captain. For higher rank very rigid examinations are necessarily required and the civilian could not pass them without military experience. That the members of the engineering profession feel the need of actual military experience keenly is attested by the fact that nearly 10 per cent of the 500 men in the citizens' training camp at Fort Sheridan, Ill., were engineers. There are many more who would go were it possible to do so. General Order 50 gives these men a chance to do something.

Cost and Value of Utilities

SO MUCH has been said and written on the subject of the fundamental principles of valuation that one is sometimes inclined to doubt whether there is anything new to be said, and to wonder whether it would not be best to say nothing more until time has dispelled the fog and enabled all engineers, at least, to see alike. Mr. Binckley, however, on page 515 of this issue, presents a phase of the problem that has at least been given much less attention than some other phases no more important. The burden of his argument, in short, is that "value" involves much besides "cost" or "investment," and that judgment alone, unaided by any formula or scale of measurement, can determine the difference. In other words, his discussion relates to "other elements of value," to use the expression coined by Congress in the Valuation Act—but not the "other elements of value" claimed by common carriers, because he hardly mentions the railroads.

Therein, the Engineering Record believes, lies one of the chief defects of Mr. Binckley's discussion as it stands. While he has shown in a private letter that he fully recognizes the importance and complexity of the differences that exist between the local-monopoly class of utility, typified by the water company, and the widespread-competitive class, typified by the trunk-line railroad, it is rather unfortunate, owing to the common failure even among engineers to perceive these differences, that he did not point them out in his article and explain that his theories fit the former class much more closely than they do the latter. Then, also, he accepts as established the "less-depreciation" doctrine, which this journal believes is contrary to reason and will ultimately be applied only to properties that have been allowed to sink to decrepitude without any provision for or possibility of the necessary renewals.

Four questions are propounded by Mr. Binckley as having vital bearing on value without entering into cost: Is the property, or can it be, a monopoly? Was there great hazard of loss at the start? Have past profits been ample or meager? Is the property likely to become obsolete?

Obviously the first question does not fit the railroad—the average railroad. Many roads do enjoy monopolies at present, but they are not guaranteed, and wherever there is traffic worth while there are promoters striving, and often succeeding, to get a slice. But for the water company controlling the only source of potable water, or the power company controlling the only waterfall, the possession of the monopoly is a very durable and valuable asset, which may not fairly be overlooked in the valuation.

The second question fits every class of utility. Mr. Binckley pictures the irrigation project put through in the hope of developing the production of citrus fruits, and it is perfectly reasonable that in return for the risk of total loss the investors be given an opportunity to make more than ordinary profits. Otherwise the money would remain in conservative investments, and such developments would never be put through. He does not mention the great railroads over the Rockies, yet most of them represent the extreme in hazard of investment, having been pushed far ahead even of civilization. It does not seem unreasonable that these assumptions of risk should be considered elements of value.

Mr. Binckley's idea of the significance of this element for purposes of sale seems to lead to confusion. He states that for such purposes the question of risk should not enter. This means, however, either that the purchaser, without paying anything for it, may acquire a claim to increased earnings due to somebody else's risk, or that with the transfer of ownership the property should suddenly lose some of its earning value. It seems more equitable that this element of value due to original risk should go with the sale and be paid for as something permanently a part of the property.

The third question leads to that sadly misunderstood term, "going value." There are those (including courts, unfortunately) who would make it vary inversely as past profits, so as to represent past deficits in earnings—in which case the skillful management which has minimized such deficits is penalized, while the extravagant and blundering management which has failed to make the property profitable may claim a staggering addition to value. It seems much more fair to estimate what it reasonably ought to have cost to bring the property to a paying basis, and add that amount as a definite, *tangible* element of value. Mr. Binckley does not make his views on this question very clear.

The fourth question, relative to obsolescence, does not seem to fit the railroad, and its significance concerning any utility is open to doubt. Sympathy for the owners of the steam power plant who have their business taken away when the near-by water power is developed will likely be tempered with the thought that the builders of the steam plant should have utilized the water power themselves. It might, however, have required a large amount of money and a chance to reach a much larger field to make the use of the water power profitable, and probably some measure of protection is desirable to encourage small developments before the large ones are feasible. But no sympathy is wasted on the railroad that becomes obsolete. It is forced by competition to match to some extent the service of its rivals, or, if there be no competition, it is forced by law to provide certain minimum facilities. Damage done it by water or electric-railway competition is regarded with holy glee, and it cannot even acknowledge itself beaten and go out of business. And none of these considerations appears to have any bearing on the valuation of the property, unless indirectly in increasing promotional expenses.

Promotional expenses, by the way, together with discounts on securities and interest during construction, answer to some extent Mr. Binckley's second and fourth questions. Prospective investors and lenders will naturally demand higher rates of return for greater risks, and these concessions become elements of actual cost that belong in the appraisal itself.

Mr. Binckley's closing appeal for a fairer attitude toward public utilities is not novel, but is nevertheless worth reiteration. The Engineering Record holds no brief for past maladministration of utilities. It does believe, however, that the punishment has already exceeded the crime and has almost wholly failed to differentiate between good and bad management, and that public expediency demands that something be done to dispel the present fear and uncertainty of the potential investor.

Coast Defense Needs

ADEQUATE protection for our coast cities is one of the fundamentals of preparedness, and since this subject is largely within the province of the engineer, albeit the military engineer, it seems desirable to point out the nature of the changes that are needed to put our coast defense system on an adequate basis and to emphasize the urgent necessity for doing this immediately.

It is a regrettable fact that our coast-defense system has been built up and maintained by spasmodic construction. Several times in the history of the United States the fortifications have been brought up to date and then almost nothing has been done for many years until the equipment was sadly obsolete and ineffective against the latest naval armament. This has been due entirely to natural conditions. Since naval vessels wear out in from 15 to 20 years and must be replaced, it has been the custom to build ships, not in large numbers, but a few at a time, so that a fleet represents a gradual evolution up to and including the very latest type. Fortifications, on the other hand, do not progress except by long bounds. Moreover, their apparently permanent character creates the false impression that they are as effective as when new. If naval armament did not improve this belief would be true.

As a matter of fact, during the past 15 years there has been no substantial improvement in the armament of the coast defense of the United States proper, and with the possible exception of two mortars in Boston harbor, each with a range of 20,000 yd., the most powerful guns mounted anywhere along our coast line have a fire control system based on a maximum range of about 12,000 yd. The grave danger of this condition is apparent when it is realized that the latest dreadnaughts of all nations carry guns with a practicable range of 20,000 yd., so that there is a zone of about 8,000 yd. within which dreadnaughts can operate against our fortifications while lying safely beyond the reach of the present coast-defense guns and mortars. It is understood that an effort is being made to alter gun carriages and reduce the weight of certain projectiles so as to attain an increase in range of several thousand yards with the coast defense armament that we now have installed. These, however, are changes that would require time, and even after the necessary computation, experiment and manufacture of ammunition, and assuming that it were a complete success, there would still be a zone in which hostile guns could safely and effectively operate against our batteries.

The remedy for the present unfortunate state of affairs is plain enough. It consists of mounting a few of our latest type rifles and mortars which have a range of 20,000 yd. at points which will cover the 8,000-yd. zone referred to. To do this would be to do very little—the very least that could reasonably be done—but it would afford partial protection. With a few pieces covering the outer zone, military authorities confidently assert that the risk to besieging dreadnaughts would be so great as to discourage attack. In most cases the higher power armament which the land fortifications require would need to include two to four guns and four to eight mortars covering the deep sea approaches to the principal harbors. Thus, taking San Francisco as an example, a complement of two rifles and four mortars would be required on either side of the entrance to the harbor, probably an installation at Fort Miley and another at Fort Barry. To the cost of these batteries, which might be about $250,000 for each gun and its emplacement and the same for each two mortars and their emplacements, a sum sufficient for supplying them with a proper amount of reserve ammunition and an adequate annual allowance for target practice should be added.

Finally, it must be remembered that even with this addition the fortifications of San Francisco, or any other harbor, would not be "completed" in the sense of finality. The use of the word "completed" in the reports of recent government boards, which have studied coast defense in order to make recommendations to Washington, is very unfortunate, to say the least, because it has helped to sustain the false sense of the security afforded by the land fortifications. Coast defenses are adequate only when they have range and power comparable to that of naval armament that may be trained upon them. Since naval equipment is being constantly improved, we are inconsistent in allowing land batteries to remain for long periods of years without any expenditures whatever.

Public sentiment would not permit such a condition to persist long if the danger were generally known and fully appreciated. It is time to pay for coast defense a premium which is long overdue.

Rush Work After Storm Restores Galveston's Water Supply and Rail Connections

Temporary Pipe Line Laid Across Causeway Wreckage in 17 Hours —Timber Trestle for Traffic Across Bay Built in One Week

By E. B. VAN DE GREYN
Consulting Engineer, Houston, Texas

WITH the passing of the storm of Aug. 16 and 17, which demolished portions of the causeway at Galveston, Tex., cut off the water supply and destroyed communication by rail between the island city and the mainland, as described in the Engineering Record of Aug. 28, page 271, the work of reconstruction was begun immediately. Every resource at the city's command was called upon, with the result that in 17⅓ hr. after work was begun water was flowing across the bay through a hastily built pipe line laid on what was left of the causeway. It took only 7 days for an army of workers to construct a mile of timber trestle to restore railway connections across the bay, and the work of repairing the damaged boulevard behind the seawall is progressing rapidly. These are the repairs for which there was the most pressing need, and while the principal efforts have been directed toward these there are under consideration several plans for the more complete protection of the city against the onslaughts of wind and wave.

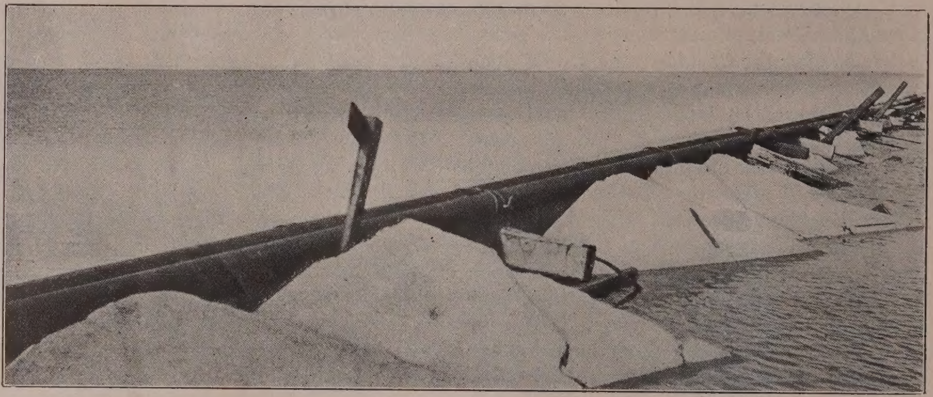
LAY PIPE LINE IN 17 HOURS

The restoration of the water supply, which was interrupted by the breaking of the 30-in. supply line on the causeway, was the first work undertaken. Before the causeway was built the water from Alta Loma was carried through a 30-in. pipe laid on the bottom of the bay nearly parallel to and about 600 ft. southeast of the present causeway. When the causeway was constructed a new 30-in. line was laid in the fill along its entire length, being submerged, of course, at the lift span. The new line was connected at the island and mainland ends with the old 30-in. line and gate valves were installed at these points so that water could be pumped through either line.

The washing out of the sand filling during the storm caused bad breaks in the 30-in. causeway pipe line at the north and south ends of the arches, and also several smaller breaks where the protected roadway was washed out. The removal of the sand filling lowered the pipe bodily until it was covered with from 2 to 7 ft. of water. At first it was thought that the old submerged line was uninjured, but after the valves were opened it soon developed that there were serious breaks in that line somewhere in the bay.

On Aug. 21 advice was asked of I. A. Cottingham, chief engineer of the Sunset Central Lines. He recommended, in view of the necessity for immediate relief, the construction of a temporary 8-in. line across the causeway. A committee of citizens later in the day went to the causeway with a letter addressed to him and Mr. Pettibone of the Santa Fé railway, turning over to them the job of getting water into Galveston.

An order for necessary pipe and fittings was at once sent back to Galveston and wired to the Southern Pacific office at Houston. Two miles of pipe were loaded and in Texas City by daylight the next morning, Sunday, Aug. 22. By Monday morning two Southern Pacific bridge gangs, city water service men, a strong force of Santa Fé men, who had been ordered by Mr. Pettibone to report to Mr. Cottingham, and the pipe, were at the causeway. Pending the arrival of the pipe from Houston an investigation was made to discover the extent of the breaks in the old submerged line. It was found that 600 ft. of the old main opposite the northerly end of the arches was displaced and about 200 ft. at the southerly end of the arches was missing. These sections were evidently snapped off by the excessive current through the causeway arches due to the restricted waterway between Galveston Bay and the Gulf.



TEMPORARY WATER PIPE LAID OVER CAUSEWAY WRECKAGE IN 17 HOURS

FIVE GANGS LAY PIPE

When men and pipe arrived on Monday morning Mr. Cottingham took active charge of the laying of the 8-in. line. Pipe laying was started from both ends of the causeway arches, from the island end and the mainland end and at an intermediate point between the mainland end and the northerly end of the arches, making five separate gangs. The pipe was laid on the concrete coping which caps the concrete sheet piling on the westerly side of the causeway, and was tied down with heavy wire to the concrete stubs where the steel tie rods came out of the coping. As the pipe-laying gangs met, the pipe was connected up with sleeves made up of sections of 10-in. pipe, the joint being sealed with lead; 3700 ft. of pipe was laid at the mainland end and 1700 ft. at the island end of the causeway. The 8-in. pipe was connected by plugging the ends of the 30-in. pipe with boiler iron caps, made in the Houston shops of the Southern Pacific railway, and tapping the ends of the 8-in. pipe in the center of the plugs. Water was ordered turned on through the 5400 ft. of temporary line at 2.20 p. m. Tuesday, Aug. 24. The laying of the 5400 ft. of pipe and the making of the necessary connections was accomplished under these adverse conditions in 17⅓ hr.

When water was thus secured, City Water Commissioner Shay started the work of repairing the submerged main. The missing sections were filled in with 20-in. flexible joint dredge pipe. At the free ends of the 30-in. pipe connection was made by divers. After slipping the end of the 20-in. pipe into the end of the 30-in. pipe the space between was packed. A submerged cofferdam was built of sacks of cement and filled with cement from other sacks lowered to and slit open by a diver. The connection was thus surrounded, and after the cement had been allowed to set water was turned through the submerged main on Sept. 5.

In the meantime the 3700 ft. of 30-in. causeway pipe line from the mainland to the north end of the arches was being patched and leaks stopped by other city forces. Along the 1700-ft. section at the island end a second 8-in. line was laid alongside the first, and on Sept. 5 water was turned through these lines at the same time as through the submerged line. This gave Galveston an ample supply. Work of repairing the leaks in the 1700-ft. length of 30-in. causeway line was carried forward, and on Sept. 19 water was turned through this line. Mr. Shay found that the submerged line drew water out of the causeway line. The submerged line, therefore, was cut off and all water is now being delivered to Galveston through the 30-in. line along the causeway.

QUICK WORK ON RAILROAD TRESTLE

Although Galveston, after the storm, had boat service which supplied food, it was imperative that rail connection with the mainland be restored as quickly as possible. An army of men was at once put at work getting tracks in shape leading to the causeway. The building of a single-track creosoted pile trestle was commenced as soon as equipment and materials could be delivered to the causeway. The Santa Fé Railway undertook the building of the 3700 ft. at the northerly end under direct charge of W. E. Maxin in the field, and the Southern Pacific handled the 1700 ft. at the southerly or island end under direct charge of Mr. Cottingham. On the 1700-ft. section a railroad driver was used at the island end and a slip or skid driver was started from the southerly end of the arches. For the 3700-ft. section a railroad driver was started from the mainland end, a skid driver from the northerly end of the arches, and another skid driver started on cribbing at an intermediate point. Materials were brought in on barges and floated to the drivers. A temporary track laid outside and to the east of the approach and extending out from the mainland was also used for bringing materials. Bents were 14 ft. on centers, four piles to a bent. Driving was carried on day and night with two 12-hr. shifts. In 7 days 5400 ft. of pile trestle was built ready for train service. With the wreckage of the causeway approaches interfering with progress, those in charge must be credited with a record job. Galveston owes much to the railway officials and men who worked so efficiently to relieve the immediate needs of the city.

Steam lines and the Stone & Webster interurban line from Houston are now operating over the pile trestle. The interurban cars are taken back and forth across the trestle by locomotive. The Stone & Webster Company is now constructing a trolley pole line next to the trestle to enable cars to operate across it under their own power.

BOULEVARD AND SEAWALL

Work on the damaged boulevard along the seawall was started soon after the storm. Scoured out places back of the wall are being filled. The brick from the damaged pavement are being piled and cleaned. Where concrete had been used for pavement base the concrete is being broken up and thrown over the seawall at the toe of the wall. In places the filling was removed during the storm from under the toe of the seawall immediately in front of the sheet piling and it is necessary that it be refilled under and against the toe of the wall to prevent teredo attacks on the piling. The broken concrete is being deposited to help hold the new filling.

Work on the streets and the moving and filling in of sand is steadily going on. In general it is only along the far seawall boulevard and a short distance inland that such work is necessary.

PLANS CONTEMPLATED

Up to the present date it is understood that no definite plans have been adopted for the more complete protection of the city and for the reconstruction of the causeway, although several plans have been and are being considered and discussed. In general, the problems to be met are as follows:

The seawall demonstrated its ability to stand the storm of last August. The boulevard and fill back of wall, however, was scoured out by water blown over the top of the wall. The new plans, therefore, will prevent such water from going on over into the city and the consequent scour or wash of the pavement and fills back of the wall.

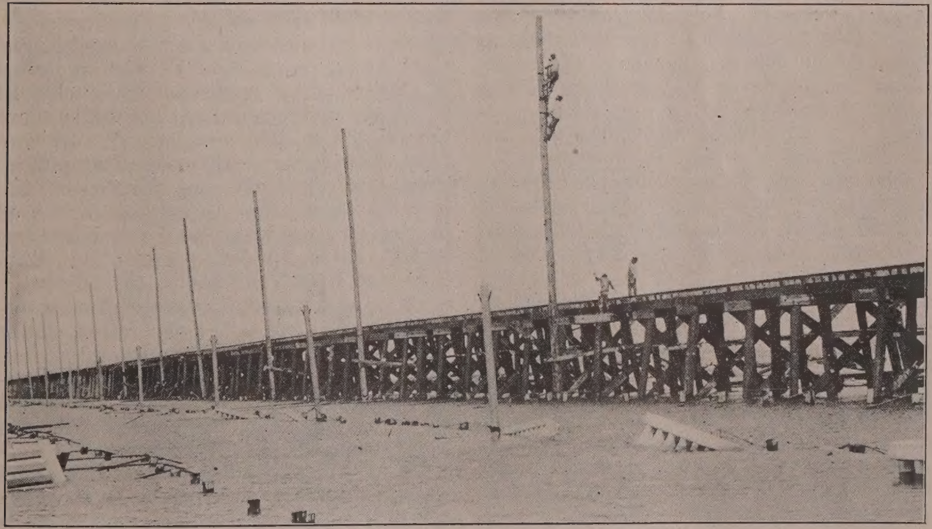
Districts beyond the protection of the seawall have shown their need of similar protection and in all probability the seawall will be extended or other protective works built for the protection of these districts.

The downtown section of the city is subject to the dead or back water during storms such as that of last August. This is to be overcome by raising the grade in the downtown district or some other method affording either partial or total protection.

The weak point in the causeway was the fill in the so-called protected roadway approaches. The fill was protected from all sides except the top and it was from there that the storm water started the destruction. Another significant feature brought out by the storm was the fact that, before the approaches gave way, the water was much higher first on one side and later on the other as the storm center approached and passed the coast line. The question arises, How much of the high water in Galveston was due to the damming by the causeway of the water between the bay and the Gulf?

Three of the plans tentatively considered are: First, an all-arch causeway necessitating expenditure of about $2,000,000; second, more substantial protected roadway approaches costing about $1,500,000; and, third, creosoted timber approaches with solid timber floor supporting ballast and pavement (no estimate).

The question of location, etc., of the water mains across the bay would naturally depend on the final plans for the causeway. Whatever is done on the works contemplated will entail great expense and the citizens and officials will doubtless consider all features carefully, since the sentiment appears to be that whatever is done should be thorough.



GALVESTON'S HASTILY BUILT TRESTLE CONNECTION WITH THE MAINLAND

Fall River Mills Will Benefit by $3,000,000 Water and Sewerage Project

Plans of Fay, Spofford & Thorndike Provide for Three-Story Conduit Separating Hot Wastes, Cold Condensing Water and Surface Drainage

By means of a $3,000,000 project, involving a three-story concrete conduit with separate channels for hot waste water, cold condensing water and surface drainage—all combined in a single structure tapping Watuppa Pond—the Quequechan River nuisance in the crowded mill district of Fall River, Mass., will be abated, 146 acres of valuable land will be reclaimed for commercial purposes, the city's great industrial plants will enjoy a practically unlimited supply of water, and the water itself will be converted from a warm, filthy stream into a cool, clear flow. These, in brief, are a few of the advantages which will be realized by the plans of Fay, Spofford & Thorndike, consulting engineers, of Boston, which have just been submitted to the City Council of Fall River by the Watuppa Ponds and Quequechan River Commission, created in 1913 for the purpose of improving the Watuppa Ponds and eliminating nuisances along the Quequechan River, which has been a recognized source of danger to the public health for many years. The pollution of the river has reached a stage likely to result in epidemics if not taken care of by a proper system of sewerage. The redeeming of the land steeped with noxious infection, and the drainage of areas hitherto included in unhealthy surroundings will remove a great menace, bring into the market areas of taxable property open to development, and provide important improvements in the water supply for industrial and condensing purposes.

RIVER CONDITIONS OBJECTIONABLE

The abatement of the Quequechan River nuisance is one of the most pressing problems in sanitation in Massachusetts. The Watuppa Ponds to the east of the city together constitute the largest body of fresh water in the State, having a total length of 8 miles, a total area of about 5.25 sq. miles, and draining a watershed of about 27 sq. miles. These ponds are at an elevation of about 130 ft. above tidewater, and are drained by the Quequechan River, which, from its source at the outlet of the South Watuppa Pond at the Sand Bar, flows practically level for about 2 miles to Pleasant Street, and then in the last half-mile of its course drops through a succession of falls to tidewater.

Many industrial plants are located along the river between the Sand Bar and Watuppa dam. By direct discharge or by the overflow of cesspools sewage from 16 miles, employing thousands of operatives, reaches the river. Much surface drainage also finds its way into the stream, the overflowed flats of which contain a large amount of sludge and other wastes, with rank vegetation which is stimulated by the heating of water when discharged through the mill condensers. Certain sewers in the vicinity of the river now are discharged into it through relief outlets. Below the Watuppa dam the larger portion of the stream is covered by streets and buildings, and the condition of the river is such that in many places it cannot be traversed by human beings. Shut-downs have occurred at various mill power plants during periods of low water, due to the high temperature of the water supplied to the condensers, to its scarcity, or to clogging of intakes. The domestic water supply of the city is drawn from the North Watuppa Pond, and the proposed improvements are planned with due regard to present and future requirements.

MAIN FEATURES OF NEW PLANS

The plans presented by the commission and developed by its consulting engineers in general provide the following:

(1) The construction of a main conduit from the vicinity of the Sand Bar along the river to a point just above the Watuppa dam, to provide for the flow of the river and for the supply of water to the mills for condensing, washing and other purposes; (2) a system of sanitary sewers discharging into tidewater to take the sewage and wastes from the mills which are now discharged more or less directly into the river; (3) a system of surface water drains to relieve the existing overtaxed combined sewers; and (4) the filling of certain areas of flats on either side of the proposed conduit to a height at least equal to full pond level of the South Watuppa Pond.

The plans provide for the complete separation of hot and cold water. A constant supply of cold water much larger than the present minimum flow of the river will be discharged downstream in dry seasons. There will be an ample supply of cold water to all the principal mills along the stream by making available water stored in the South Pond at depths lower than that to which it is now possible to draw the pond. Finally, the hot water from the mill condensers will be returned to the South Pond, where it will be cooled and made available for further use. The design contemplates a main conduit consisting of a single structure with three separate channels, superimposed. In this conduit the cold water channel is placed at the bottom and the hot water channel at the top of the structure, and between the two is a surface water channel for the removal of storm water from the watershed draining to the river to an outlet below the Watuppa dam. Thus the flow in different compartments of the conduit will be in opposite directions.

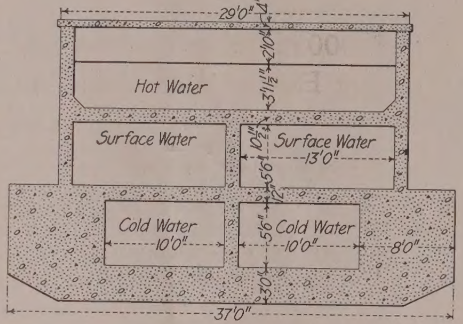
The inlet for cold water and the outlet for hot water are widely separated, and provision for oil separation is made at the discharge of the hot water duct. It is also planned to turn the hot water into either the surface water channel or the cold water channel when needed to prevent the interference of ice. Another feature is an overflow into the South Pond from the surface water channel in case the latter should become surcharged in an excessively heavy rain.

At the lower end of the conduit near the Watuppa dam structures are provided for the discharge of water down the old channel of the river, estimated to have a carrying capacity of 250 sec.-ft., and a new outfall sewer having a capacity of 535 sec.-ft. is to be provided for the removal of sewage and storm water. This new sewer can be used in emergencies for the removal of flood waters from the South Pond, and is to find outlet in the Taunton River at tidewater.

SEWERS AND DRAINS

The plans for sewerage and drainage provide for the separation of sewage from storm water in the valley of the Quequechan River and for maintaining separate systems in this valley in the future. At first, however, it is proposed to construct only such sewers as are necessary to effect a partial separation, preventing a mingled overflow into the Quequechan River. The plans have been approved by the State Department of Health, and under the scheme presented the mills below the Watuppa dam will have every day in the year an available supply of water more than double that which it is possible to obtain at present during the dry months. The character of the water will also be entirely changed. Instead of being hot and filthy it will be cold and clean, with a practically unlimited supply for the mills above the dam. The redemption of the flats will make available 146 acres for commercial purposes.

By filling the flats, as proposed, water storage capacity of about 250,000,000 gal. will be lost. This will be offset many times over by the greater storage made available in the South Pond. At present it is not possible to draw the South Pond down more than 4.5 ft. below full pond level, thus utilizing a storage capacity below full pond of less than 2,250,000,000 gal. It is planned to utilize a storage capacity of 3,750,000,000 gal. by drawing down South Pond to a depth 8 ft. below full pond, or an increase of nearly 70 per cent, which is six times the storage lost by the filling of the flats. The Quequechan River flow falls as low as 8,000,000 gal. per day, and sometimes less in dry years, whereas with a deeper channel and better regulation a constant flow of at least 20,000,000 gal. can be obtained at all times.



CONDUIT IN WHICH HOT AND COLD WATER WILL OCCUPY SEPARATE CHANNELS

The adoption of the scheme provides for the ultimate construction of 60 miles of sewers, which, when completed, will properly drain areas in Fall River now without sewer sanitation. Only 5 miles of sewers need be built at the outset. The outfall sewer is designed to care for a flow of 450 sec.-ft. in excess of the maximum flow of the sewers contributing to it. After the proposed improvements are completed it will be possible to draw off water from above the Watuppa dam to the Taunton River at the rate of 700 sec.-ft. or nearly three times the previous rate. The cold water and surface water channels in the main conduit have a still greater capacity for flood discharge, affording increased safeguards against threatened rises in the pond.

As most of the schemes previously proposed for a conduit contemplated the building of a water-tight dam at the Sand Bar, a large number of borings was made in the attempt to discover a suitable site for such a dam. It was found that on account of unsatisfactory foundation conditions, such a dam would cost $60,000, while a cut-off can be built at Quequechan Street at a cost of less than $2,000. The saving on this one item pays for the cost of underground explorations many times over.

In studying the question of drains for surface water, it was early apparent that main surface water drains or conduits would naturally be built along the routes of the proposed cold-water conduits. It was found to be far more convenient as well as economical, wherever a surface-water conduit was needed, to combine it with the cold-water and hot-water conduits into a single structure. This led to the adoption of the three-level type of conduit. The cold-water channel is placed at the lowest level where it will always flow full; the hot-water conduit is placed at the top, so that the discharge from the mill condensers will be returned by gravity to the South Pond; and the intermediate level is utilized for surface water. The main conduit is, in general, to be built level for its entire length; the floors of both the cold-water and surface-water conduits are level, and the floor of the hot-water conduit slopes slightly toward the South Pond. The main and branch conduits are to be built of reinforced concrete.

HOT AND COLD WATER SEPARATED

The separation of the cold water, hot water and surface water in different channels is preferable to the combination of any two of them in a single channel. Were the hot water discharged from the mills admitted to the channel containing the cold water, it would not be possible to keep the water supplied to the mills cool and free from oil. With separate channels, water that has passed through the mill condensers can be clarified and cooled, and rendered as useful as before entering the condensers. If surface water were admitted to the channel carrying cold water to the mills the latter, in times of storm, would be supplied with water containing both grit and organic impurities, for in the narrow confines of a conduit it is not possible to keep the water supplied to the mills diluted or to settle out the impurities. There would also be danger of flooding the mills during heavy storms. The admission of surface water to the hot water channel is equally undesirable. As the mills above the Watuppa dam are already drawing from the river more than the maximum allowable steady draft upon the South Pond it is necessary that the water thus used in the mill condensers be saved and returned again to the pond. The State Board of Health objects to the admission of storm water from the Quequechan watershed to the pond. The separation of the three classes of water has proved so important that in addition to the separation of channels in the conduit the points at which these channels connect with the pond have been widely separated.

In the type of conduit proposed, the cold-water channel is placed at a level wholly below the lowest elevation to which it is proposed to drain the South Pond. The conduit will therefore be kept filled at all times with cold water, and as the water will flow under pressure, it will rise in every mill intake substantially to pond level. In the combination conduit proposed, the cold-water channel can be located at a low level with substantially the same cost as if built at a higher elevation. The avoidance of complex connections is insured by the three-level design. This type of conduit occupies minimum ground area, reducing the cost of foundations. With the single structure, in which the cross floors serve at both top and bottom as conduit walls, a saving in material is effected, with a further saving from the fact that the two cross floors act as braces. By utilizing for the surface water conduit the space between the hot and cold water conduits that otherwise would be wasted a saving is effected which would at least equal the entire cost of constructing a large, independent surface-water drain along the valley from the Sand Bar to the Watuppa dam.

CONDUIT DESIGN

In the design of the main conduit, except in rock excavation, the base below the level of the bottom of the surface-water conduit is made broad and heavy to resist possible unbalanced lateral pressure on the side and possible upward pressure from water below. But little reinforcement is required here, and the broad base furnishes a suitable distribution of the weight of the conduit over the underlying earth. Above this base the vertical side walls and floors of the surface-water and hot-water conduits are of thin, reinforced concrete construction of an economical type. In the larger sections, where side walls are widely separated, a center reinforced concrete wall is used as an intermediate support for the floors of the surface-water and hot-water channels. Openings are to be provided at intervals in these center walls to equalize the flow. The hot-water conduit is covered with a reinforced concrete roof to protect the public, keep out intruders, to prevent the channel's becoming a nuisance by the accumulation of refuse, and to reduce the liability of freezing. In rock excavation a smaller base section will suffice. Except for variations in size and in the omission in certain cases of the surface-water channel, the branch conduits are in general similar in construction to the main conduit above described.

The usual provision for expansion is to be made in both main and branch conduits, joints being watertight. In addition to the vertical expansion joints provision is also to be made for the expansion of the hot-water conduit independently of the remainder of the structure beneath it. Not only will the hot-water conduit be separated from the surface-water conduit by horizontal expansion joints, but the reinforced-concrete beams supporting the roof are to be cast independently of the walls and the roof slabs are to be independent of both.

BASINS AND OTHER DETAILS

Detailed designs have been prepared for oil-separating and cooling basins, grit chambers, manholes and mill connections. At present the mills above the Watuppa dam, when operating at full capacity, develop a total of about 55,000 hp. and consume about 30,000,000 gal. of water daily, mainly for condensing purposes. At flood times there is no difficulty in securing ample water of satisfactory temperature, but with the limited flow of the stream during dry seasons re-use of the water becomes frequent, with decided disadvantages from the power production standpoint. The scheme proposed assumes that ultimately 125,000 hp. will be developed in the mills, and that a draft of 75,000,000 gal. per day will be required. In general, it will be necessary to provide new channels to carry the water from the present mill condensers to the hot-water conduit. The intake pipes are to be of reinforced concrete, designed to take water from either the cold or surface water conduits or both, and the discharge pipes will be of wooden flume construction for the time being.

The general scheme of construction contemplates the building of the main conduit and its branches in the dry, the site being inclosed by dikes. Continuous service to the mill plants will be rendered throughout the construction period, principally by wooden flumes of temporary character. The outfall sewer will first be built, to drain the excavation for the conduits before their construction begins. Detailed estimates of construction cost have been prepared and are published in the report. Summarized these are: Main conduit, $1,655,945; initial sewers, $290,835; drains for surface water, $162,725; filling flats, 1,260,000 cu. yd., $483,000; total construction cost, $2,592,505. Damages and general expenses bring this to $2,942,505. The estimated total net cost of the initial improvement, taking into account the sale of land reclaimed and assessments, is $1,142,505.

$3,000,000 Needed for Improving Boston's Streets

Report of Finance Commission a Survey of Present Conditions and How They Can Be Bettered—Shallow Granite Block Advocated

RECOMMENDING an expenditure of about $3,000,000 for pavement improvements and advocating a change in grouted granite block construction, whereby a 4-in. instead of a 6-in. depth of block would be used, the Boston Finance Commission, through Guy C. Emerson, consulting engineer, has submitted to the Mayor and City Council a report on the betterment of the city's streets. Since 1913, the report states, there has been a deterioration in the streets, principally in main thoroughfares, and the foregoing sum will be required, in addition to the usual yearly appropriation, to place the street surfaces in a proper condition. Of this amount, about $1,000,000 must be expended to repave portions of the streets between street railway tracks.

PAVING CLASSIFIED

Exclusive of areas occupied by street railway tracks, there was a total of 11,009,322 sq. yd. of pavements on accepted streets in Boston on Feb. 1, 1915. Of this area 2,323,673 sq. yd. was stone block; 175,868 sq. yd. was wood block; 110,863 sq. yd. was brick; 7,825,952 sq. yd. was macadam; 531,074 sq. yd. was asphalt bitulithic; and 41,892 sq. yd. was cobblestone and wood plank. There are about 584 miles of public ways in Boston under the charge of the Department of Public Works, 45 miles of roads in charge of the Park Department, and 250 miles of private ways which have been opened for traffic under consent of the street commissioners, but which are maintained by abutters.

Discussing various forms of paving, the report states that granite block paving filled with a mixture of Portland cement grout and sand could be easily improved and cheapened by using a block of 4-in. depth or less, on a concrete base, instead of the customary 6-in. depth. This would allow smaller joints and smoother surfaces, with improved filling and decreased cost. The extended use of such improved pavements in Boston has been prevented by the need of easy replacement in connection with the work of public service corporations on their underground structures, and the drawbacks of slipperiness.

Up to 1910, the guaranty period on asphalt pavement in Boston was usually ten years, but on request of the contractors this was reduced to five years, as in many other cities. Some of the asphalt pavements laid since 1910, according to the report, indicate that the reduction in the length of the guaranty was a mistake, as extensive repairs have been required. Asphalt has been used to the greatest degree in the Back Bay district. In this part of the city the streets are filled over marsh areas and are continually settling, with consequent breakage of pipes and other structures underground. Constant digging up and relaying shortens the life of the pavement and great care is needed in construction. The asphalt pavements now being laid in Boston are exclusively of the bitulithic type.

WOOD-BLOCK PAVING IN BOSTON

Wood block paving was begun in Boston in 1900 on Tremont Street, between Park and West Streets. The blocks were of long-leaf yellow pine, 4 in. wide on the face and 4 in. deep. This material was saturated under heat and pressure with a mixture of creosote oil and rosin, to the amount of about 20 lb. per cubic foot of wood. The pavements were high-priced, but had more of the qualities of a perfect pavement than any other pavement so far used, with the possible exception of asphalt. The experiments were so satisfactory that large areas have since been laid and are being laid. Unfortunately none of the more recent pavements, the report states, has been as satisfactory as the first. The sample on Tremont Street, now about 15 yr. old, is probably the best wood pavement in Boston, and from present indications it will outwear much of the wood pavement now being laid. Recent experience shows that it is doubtful if the wood blocks now being laid will last 5 yr. with the demands of traffic downtown, as the quality of materials is said to have deteriorated greatly. In some cases the long-leaf yellow pine, an inferior wood, has been substituted for the short-leaf variety. Smaller blocks are laid, 3 in. on the face instead of 4 in., and the standard depth is now 3.5 in. instead of 4 in. On some streets gumwood was tried, but this required too extensive repairs.

Further experiments with brick paving are desirable, especially on streets devoted to various branches of the automobile business.

REPAIRS NEEDED AND COST

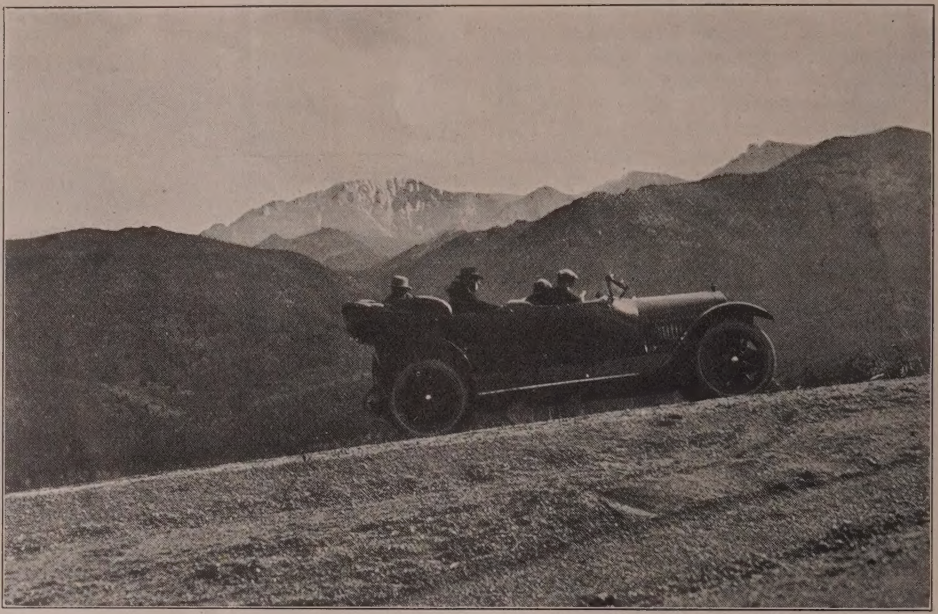
The street areas needing repairs on Aug. 1, 1915, covered relaying 84,170 sq. yd. of granite; repaving 199,680 sq. yd. of granite; resurfacing 863,750 sq. yd. of macadam; resurfacing 4510 sq. yd. asphalt; repaving 470 sq. yd. of brick; total, 1,152,580 sq. yd. This means that 10.47 per cent of the total street area is in need of repair. The estimated cost of doing this work per square yard is: For relaying granite block pavement, 0.75 cents; repaving granite block, $4.75; resurfacing macadam, $1.10; resurfacing asphalt, $1.50; and relaying brick, $1.75.

The reasons for the deterioration of the streets since 1913 include decreased appropriations, increased amount necessary to be expended for old-age pensions, decreased efficiency of the day labor force, and decreased liberality of street railways with respect to inter-rail and bordering pavements. In the past ten years the length of streets to be maintained has increased from 503 to 590 miles, with no material increase in appropriations for maintenance. Non-productive old-age pensions total $44,000 for the present fiscal year. For the present year the amount available for street maintenance is about $1,155,000, or about $237,000 less than for 1914. In 1912 the cost per mile for resurfacing macadam was $8,828, or 72 cents per square yard, and in 1914, $15,847, or $1.10 per square yard. Not over 6 per cent of this item may be due to increase of wages for the labor force amounting to 25 cents per day, taking effect in 1913, and another small percentage to the use of a greater quantity of bituminous binder in the last two years. These two items probably do not amount to an increase of over 15 cents per square yard, between 1912 and 1914, and the greater part of the increase is therefore laid to the inefficiency of the labor force and to poor supervision. This increase in the cost of resurfacing macadam streets resulted for 1914 in the expenditure of 39.8 per cent of the total appropriation for such work, against an expenditure of 28.2 per cent in 1912.

PAVING BETWEEN TRACKS

Many of the streets occupied by the tracks of the Boston Elevated Railway, according to the report, are practically impassable to automobiles and light teams, the traffic being concentrated on the narrow strips on each side of the tracks; deterioration, therefore, is rapid. There are about 188 miles of single track on regularly traveled streets. In the city proper and districts where other than macadam paving is used, the paving of the company's tracks is in general kept in approximately the same condition as the pavements in the remaining portion of the street. In macadamized districts it is the practice of the company to pave an area of the street about 15 ft. wide, in which its tracks are placed, with granite block pavement laid directly upon the soil or upon the ties. Old style blocks, often badly worn, are used. The paving between the ties invariably settles badly.

About 36.1 miles of double track are in such condition that the pavements are not used by vehicles, whenever it is possible to use the sides of the streets. The local area of tracks needing repaving is about 305,000 sq. yd. If this were to be replaced with modern granite or wood block pavement laid on a concrete foundation, the cost would be about $925,000. The remedy appears to be an arrangement whereby the company would discontinue the laying of inferior pavement, repaving and new work being done in harmony with the paving of the adjoining street area. The amount received annually by the city in special taxes from the company, if applied to the maintenance of pavements in streets where tracks are laid, would probably be more than adequate to keep the entire surface of the streets in permanent repair. It would be economical, according to the report, for the city to repave the entire street areas, including those occupied by tracks, to fit the entire street for the use of vehicles, instead of depending on the street railway to pave the track areas in such manner and with such materials as it sees fit. On account of changing conditions in various parts of the city, caused by the invasion of business into residence districts considerable areas of macadam should also be repaved with a permanent pavement.



STEEPEST GRADES CAN BE NEGOTIATED EASILY BY AUTOMOBILES

Build Scenic Highway up Pike's Peak

Forest Service Permits Private Capital to Construct Toll Road Having 19 Hairpin Turns and 10 Per Cent Ruling Grades

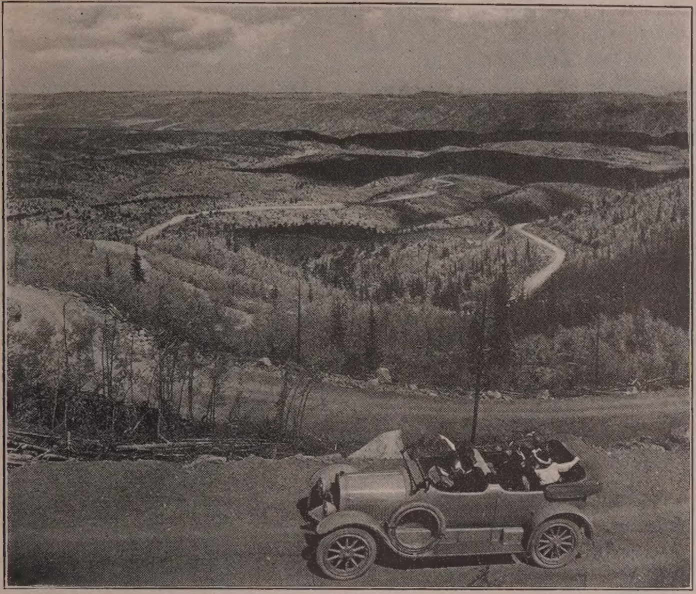
AUTOMOBILES can now ascend Pike's Peak, Colorado, over a new 20-ft. scenic highway having 10 per cent ruling grades, a maximum curvature of 96 deg. and hairpin turns of 60 and 40-ft. radii. Starting from Cascade, a small town 12 miles from Colorado Springs on the Pike's Peak Ocean-to-Ocean Highway, the new 18-mile road follows closely the old Government carriage road built by army engineers more than 20 years ago to connect with the observation station maintained at the summit. The road is wholly within the Pike National Forest and was built and will be operated by private capital under rules and regulations laid down by the U. S. Forest Service to protect the public. Its location was shown in a map accompanying brief notes regarding the new route published in the Engineering Record of June 19, page 769.

This is one of the many enterprises which the Department of Agriculture has been fostering to promote the "See America First" idea. Tourists may use their own machines on the new road, but the operating company has provided a fleet of cars running on schedule from Colorado Springs. The Government has insisted that brakes and engines on all cars be inspected rigidly at Cascade and at the summit. Service cars will also patrol the route, and a paralleling telephone line will make assistance quickly available.

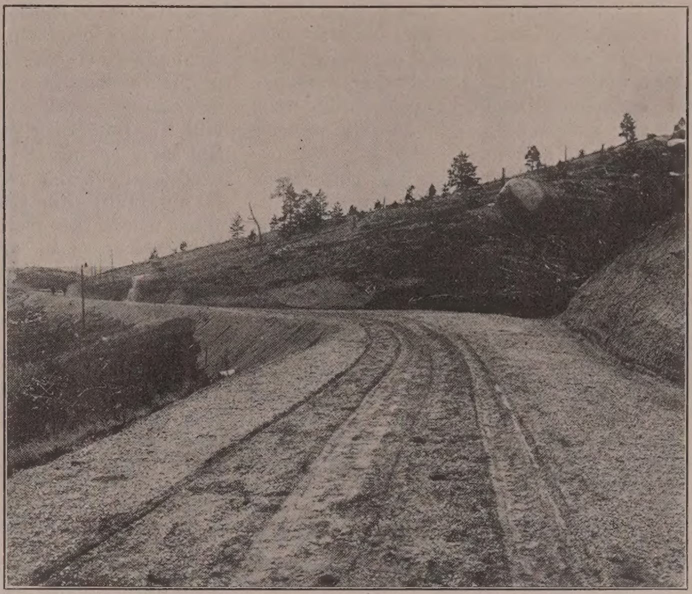
RISE OF 6678 FEET

Starting at Cascade, which is situated in the mouth of Cascade Canyon, at an elevation of 7415 ft. above sea level, the 6678-ft. rise to the peak is continuous with the exception of two light adverse grades. More

WIDE-TIRED MOTOR TRUCKS ROLLED ROAD WHILE HAULING SUPPLIES



AT MILE 10 AN IMPRESSIVE PANORAMA IS UNFOLDED



DISINTEGRATED GRANITE IS USED FOR ROAD CONSTRUCTION

than one-half of the distance is on 10 per cent grades, the average ascending grade being 7.4 per cent. The alignment for most of the distance is curved and the average curvature is 40 deg. While the standard width is 20 ft., providing for a double track the entire length, the roadbed is widened to 26 ft. on the sharpest curves, and turn-outs are provided at intervals for observation and repairs. Six water stations are spaced at intervals of 3 miles.

ROUTE FOLLOWS OLD ROAD

The first 2 miles constitute one large switchback used in order to gain elevation and enter Cascade Canyon just ½ mile above Cascade. In this section the alignment deviates from the carriage road, adding 1246 ft. to eliminate three bad uncompensated curves and to reduce the grade to 10 per cent. At Toll Gate Point, near the end of mile 2 a center fender or curb of concrete 15 in. high was placed on a sharp turn made at the foot of an adverse grade to separate the opposing lines of traffic. Mile 3 follows water grade up the south fork of Cascade Creek, and in miles 4 and 5 an ascent is made to the divide between this and the Crystal Creek watershed by ½ mile of 10 per cent grade and then a series of 10 per cent and lighter grades. Near the end of mile 5 Crystal Creek summit is gained, and then in mile 6 the creek is crossed at a watering station, where all traffic is inspected. Ascending from this brook the route leads to the next divide, along which is gained the foot of the main Pike's Peak range. In mile 7, after ½ mile of undulating grades, begins the real climb to the foot of the range.

Glen Cove, at the end of mile 11, is a 160-acre tract of fairly flat land, making a natural retreat or resting place. It lies at the foot of the main Pike's Peak range and is at El. 11,450, the last of the timbered area, and furnishes an ideal spot for a tourist hotel for those desiring to ascend the peak at sunset or sunrise.

TEN SWITCHBACKS

Leaving Glen Cove the last ascent to the range for the next 3 miles encounters a series of ten switchbacks or hairpin turns, six in two W's, with two preceding and two following. A 4 per cent compensation is applied to the 40-ft. radius curves and 6 per cent to the 60-ft. radius curves. This alignment is up the nose of the range, and is practically the only route over which the top of the range can be reached, for on all other routes proposed there is sloping country existing at angles of repose which do not afford safe, permanent or economical road-bed sections. This nose lies between the precipices which make up the confines of Glen Cove and the sheer walls of the Bottomless Pit on the east side of Pike's Peak. From many observation points on these curves are visible views of the plains to the north and east, estimated to cover 60,000 sq. miles, an area larger than the State of Illinois. Miles 15 to 17 follow the range on 4 to 10 per cent grades; the last mile contains three switchbacks, by which the summit it gained.

MILE 4—ROUNDING TURN ON A TYPICAL BOULDER FIELD

The cross-section of the road-bed is a parabolic curve, tangent to the outside, being 0.4 ft. higher on the outer edge on tangents and 1¼ ft. on curves. All of the sharper out-curves are super-elevated for 15 miles per hour. A surface ditch, dug continuously along the inner edge of the road, leads the water alongside the roadway to culverts. The inner banks are cut to slopes of 1 to 1 or steeper depending on the material, and the outer embankments are 1 to 1½ slopes, ending in dry masonry toe-walls. Masonry parapets for guard rail walls on curves, 2½ ft. high and 18 in. wide, are provided as needed.

Five bridges of 10-ft. span are of the reinforced concrete ballasted deck type with I-beams in the concrete floor slab and the balustrades acting as through girders. They are designed to support a live load of one 5-ton motor truck and two 12-passenger buses, all loaded. They are located only on tangents and can be seen at least 300 ft. away. For smaller openings Armco corrugated pipe culverts set with concrete head walls are used mostly, together with a few concrete box culverts. The minimum "sight distance" has been fixed at 200 ft., except in two places, where 125 ft. has been all that could be obtained. The average is 400 ft.

SURFACE IS DISINTEGRATED GRANITE

For most of the way a natural surfacing material existed on the ground. It consists of a disintegrated granite containing various percentages of clay. The proper mixture was secured by a distribution of the granite and clay for the mixture by a motor truck. No other road machinery was used beyond ordinary slip scrapers, fresnos and one blade-grader for finishing the grading. Excavating and rock drilling were carried on by hand.

Maintenance began with the completion of the first mile, for all supplies for the camps and all materials had to be transported over the completed road. For this hauling wide-tired White trucks, which acted also as road rollers, were employed. Snow-plows driven by caterpillar tractors are contemplated to lengthen the season as much as possible. Occasionally there are heavy snows on the upper reaches even in mid-summer.

The location and construction was carried out along lines similar to those used in railroad work, the usual estimates, maps and profiles being worked up following the locating survey party. In the latter there were ten men, while the three construction residencies had a corps of three men each.

The grading was done by contract with William Flick of Denver. Bridges, culverts and pipes were built by company force under the direction of Shelby Hare, superintendent of bridges, reporting to A. G. Allan, chief engineer of the Pike's Peak Auto Highway Company. A. E. Palen was detailed by the Office of Public Roads as district highway engineer for the Forest Service.

The road was laid out and designed according to standards set forth by the Forest Service. The requirements of the survey, plans and specifications to be presented and acted upon, and also those requirements for the many various physical features to be used in the construction as well as the general location, were studied and decided upon by the engineer representing the Forest Service before they were approved by the district forester and the construction started. The Government of the United States, acting through the Forest Service, took a very keen and active interest in the promotion of the project and in the prosecution of the construction, as well as in obtaining the highest practical grade of results that were possible to be had with the most economical first cost in order to make the road safe and serviceable to travel and a practicable one to maintain.

Concrete Eliminates Soft Spots in Railway Roadbed

Slabs Easily Placed and More Effective than One-Man Stone for Stretches Where Tile Drains Are Not Feasible

By J. T. BOWSER
Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

MAINTENANCE-OF-WAY officials on many roads are familiar with the soft spots which develop, due to inadequate drainage, in cuts in roadbed where the material consists of certain kinds of clay. Many of these are scarcely more than a rail or two in length and are usually due to lack of proper drainage. In nearly all cases they can be economically remedied by the use of drain tile, but in some cases where there is only a small place in a long cut, the expense of carrying the tile drain to some point where the water can be disposed of is so great that other means must be found to remedy the trouble. The practice of many section foremen to remedy such places by placing one-man stone under the ballast bed after removing the material in the roadbed to a small depth is, at best, only a temporary remedy, and the place will continue to give trouble each year in the early spring. An improvement of this practice by using concrete has been found to eliminate this trouble entirely, and in cases where this method has been used the improvement promises to be permanent.

The method consists in the casting, in place, of a concrete slab under a part or all of the track where the soft place is located. This at first sounds expensive. No forms are required, however, reinforcement is not absolutely necessary, the mixture is comparatively lean, and work can be handled by the section forces. Consequently the expense is not out of proportion to the advantage gained.

How to Place the Slab

The construction of the slab can be handled quite economically as follows:

The width of the roadbed permitting, the track is lined away about 1 ft. from the side on which the spot gives the trouble. (As a rule these spots affect one side only.) The ballast is then removed from the space in which the slab is to be placed, back about underneath the near rail. An excavation is then made in the roadbed to a depth of from 2 to 3 ft., and concrete is placed in the excavation up to, or a few inches below, the level of the road bed. The inside edge of this concrete is left quite rough to insure a good bond with the balance of the slab, which is placed later.

When this section has set the track is lined back to normal and the ties are blocked up on the completed section of the slab. Alternate ties are then removed to facilitate the excavation under the track. This excavation is usually made back to or slightly beyond the center of the track, depending on the nature of the soft spot. Concrete is then placed in this excavation, care being taken to cleanse the inner edge of the completed section, so that the bond may be as nearly perfect as possible. When the second section of the slab has set, the track is put up on ballast and the outer edge of the slab is covered with earth so that no difference in the roadbed is shown.

If the material in the roadbed is very soft, longitudinal reinforcement may be necessary, but as the ballast seems to distribute the load quite evenly, there appears to be little chance of the slab breaking. In fact, little trouble would result from such breakage, as the weight of the slab would probably hold it practically in place.

This construction is hardly adapted to long soft places, but for pockets of a rail or two in length it seems to serve the purpose admirably. While these pockets usually give trouble only on one side of the track, but where both sides are affected, the operation can be repeated from the opposite side. The ballast is thus given a solid bearing, and with the loads distributed over a large area the soft material is not so readily displaced and there is little or no settlement.

The Louisiana Highway Department, in its latest annual report, recommends that the one-fourth of one mill tax be increased to one mill. The present tax, which is the department's sole source of revenue, amounts to $125,000 per year.

Urges Treatment of District of Columbia Sewage

In Latest Annual Report Superintendent Asa E. Phillips Discusses Plans for Sewerage District and Waste Utilization

RECOMMENDATIONS for the installation of sewage treatment works and the creation of a metropolitan sanitary district are the chief features of the annual report of Asa E. Phillips, superintendent of the sewer department of the District of Columbia, for the fiscal year ending June 30. Mr. Phillips says, in part:

An important part of the year's work involved a preliminary study and outline plans for sewage treatment works for the District of Columbia. This work has been advanced on account of the great importance of securing a suitable site in advance of development in the very limited area within which these works must be located. Several years will be required for the development of the plans for the works, but it is considered essential that a suitable area of sufficient size for future development be secured without delay.

Not less than 12,000,000,000 gal. of untreated sewage was discharged into the Potomac River by the District of Columbia during the past year. Hundreds of tons of removable organic and other matter, possessing a certain economic value, represents part of the burden carried by the river waters under the existing method of sewage disposal. With the increasing population and the growing demand for greater refinement in the disposal of the sanitary waste of cities it is believed not too soon to begin the preparation of plans for sewage treatment works for the removal and utilization of this waste material.

The pollution of streams discharging from adjacent Maryland towns is now very apparent and is steadily increasing. The subject has been a matter of investigation by the Maryland State Department of Health and the Bureau of Sanitary Engineering and a comprehensive report advising the creation of a sanitary district and providing for measures of relief in co-operation with the District of Columbia was submitted to the State Legislature at its session January, 1914, but no legislative action was taken on this report. In view of the legislative action authorizing the Maryland State Department of Health to order the installation of sewerage systems in towns bordering on the District of Columbia, it is considered advisable that legislative authority be obtained from Congress authorizing the Commissioners of the District of Columbia to enter into agreement with the State authorities to secure the abatement of these conditions, which within a comparatively short period, it is believed, will become sufficiently serious to constitute a nuisance.

The interests of the District of Columbia are so immediate and the conservation of the purity of these streams so important as a measure of protection to the great national parks through which they flow, that in the interest of public health and sanitation it is necessary that some adequate remedy in the form of a metropolitan sewerage district be applied.

The Manufacture of Cement in California plants where electrical energy is used is estimated to require an average of 1 hp. per barrel of cement produced.

Virgin Country Renders Concrete Pipe Line Construction Difficult

Central Casting Yard Supplied Lengths for 42-Inch Line More Than 27 Miles Long—Narrow-Gage Line Transported Sections to Place

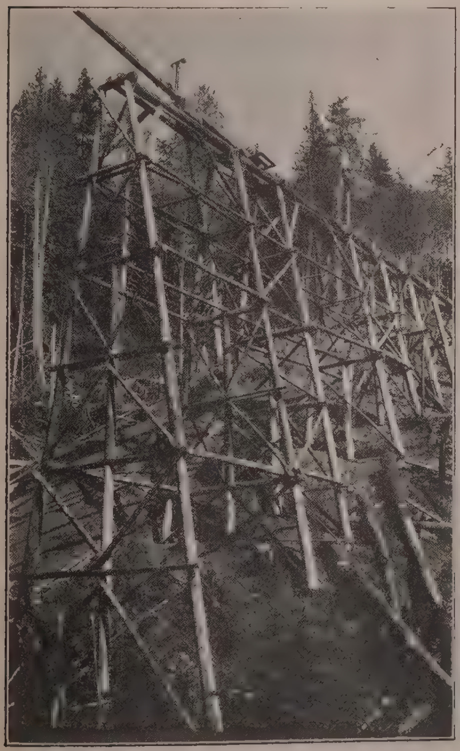
By BOYD EHLE, M. Am. Soc. C. E.
Of the Sanderson & Porter Engineering Staff—Resident Engineer, Sooke Lake Water-Supply System

IN AN EARLIER article (see the Engineering Record of Oct. 2, page 406) the writer described some of the features of the new Sooke Lake water-supply system for Victoria, B. C., and gave costs on some of the work. The chief feature of interest in this project was the reinforced-concrete flow line made of lock-joint pipe, 42 in. in diameter, and used up to heads of 90 ft. with satisfactory results. The line is 27.3 miles long, winding through inaccessible mountainous country. This article will discuss the construction of the concrete line.

EXCAVATION

When the use of a wood-stave pressure conduit was found inadvisable, the reinforced-concrete pipe was built as a flow-line conduit laid on an 8-ft. roadbed, excavated along the grade contour. This increased the estimated quantities of excavation to 270,000 cu. yd., 47½ per cent of which was earth. The original contractor did 80 per cent of the earth and 95 per cent of the rock before his failure. As much as possible of the grading had been sublet to station men. The work, except for a few through cuts, was generally side-hill excavation and only the usual simple hand tools that could be easily packed in were used. At the deep cuts light cars and track were used. The rock for about 2½ miles from Sooke Lake was schistose and the remainder hard trap.

When the engineers took over the work, the excavation was pushed to completion as rapidly as possible. Track material and equipment were ordered for a 2-ft. gage construction railway on the flow-line grade, for which temporary log trestles were built across the drainage crossing. A cable incline tramway, 2225 ft. long, with a rise of about 450 ft. was built to give access to the flow-line grade at Coopers Cove, a point about 17½ miles from Sooke Lake, the head of the line. Yard tracks at the foot of the incline ran to a wharf on tidewater at Sooke Harbor, and extended through the pipe manufacturing plant. Three 10-ton donkey engines and about seventy flat cars were used. About twenty-five of these cars had been converted from dump cars used in the excavation, and the remainder were built as required.

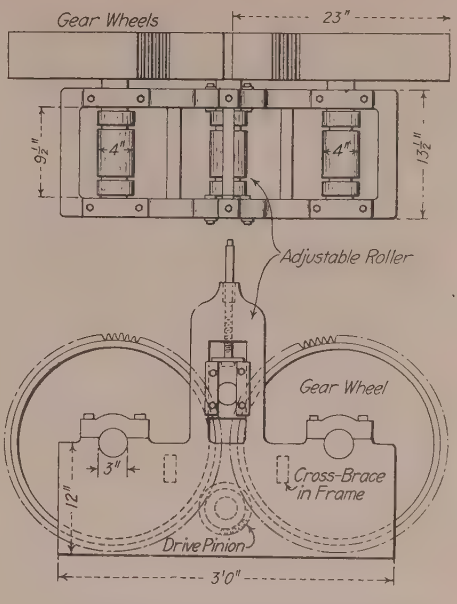


ROUND TIMBER TRESTLES BUILT FOR TEMPORARY WORK

CONSTRUCTION TRESTLES

The plan of the temporary trestles is shown in one of the drawings. These trestles were rapidly and economically erected by handwinch power and a truss boom (also illustrated herewith) on rollers. The bents were framed on the ground and lifted to place. These trestles were located close to the downstream side of the permanent concrete trestles. The only sawed pieces used in the trestles were the 4 x 6-in. bridge ties and guard rails. All the important trestles had water barrels, were floored, and had sand filled in between the tracks for protection against fire from the engines.

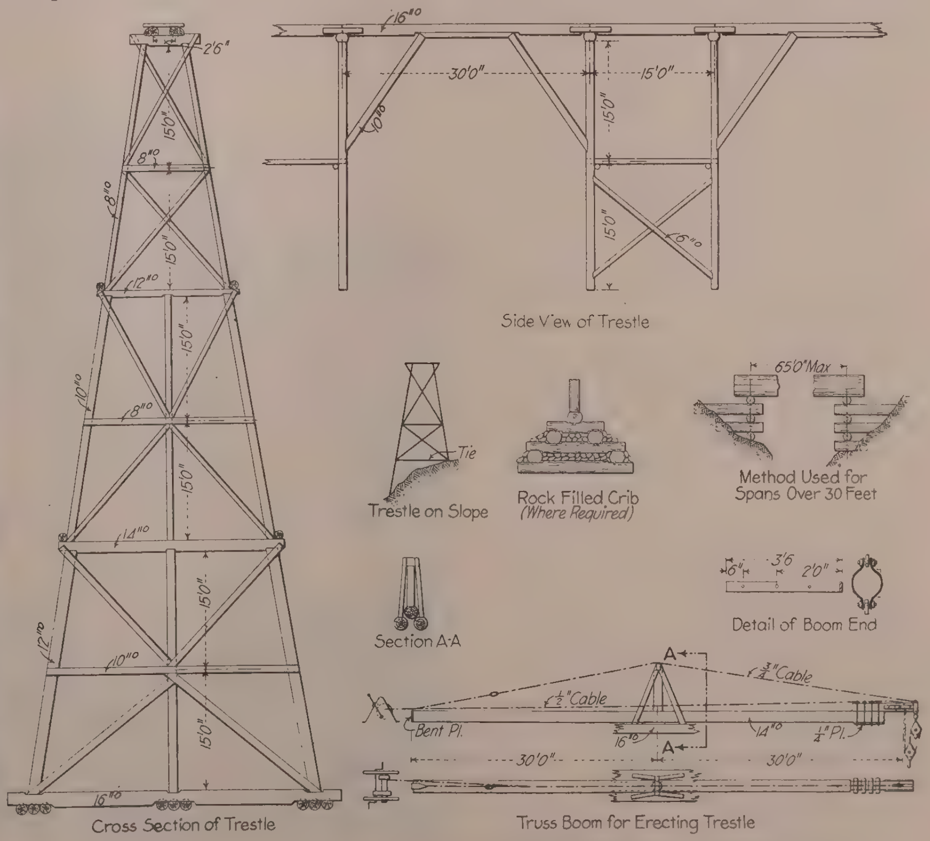
The construction track was of 20-lb. rail and split ties of Douglas fir on rock ballast. Side tracks were cut in wherever they could advantageously expedite the work. For the curves the track rails were bent by the primitive but very effective way of laying them on abutments, bending them with levers at the quarter points to the required shape and hammering them from each end up to these points until they took a set.



RAIL BENDER FOR CONSTRUCTION TRACK

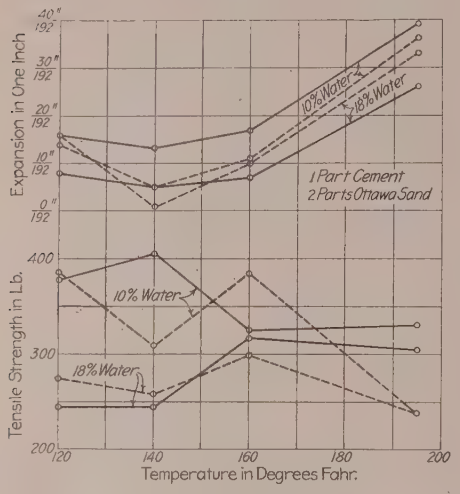
CONCRETE TRESTLES

As fast as the railway was available the concrete aggregate, reinforcement bars, lumber, etc., were hauled out and the permanent drainage structures were started. The concrete trestles, generally on sharp curves, were the chief item, and several small modifications were made in the plans during construction. On account of the increase in size of the pipe from 40 to 42 in.



TRESTLE BENTS, ON 30-FOOT CENTERS, WERE ERECTED WITH A TRUSSED BOOM four saddles were used on the 15-ft. spans and the reinforcement increased. The span was increased to 30 ft. over the large creeks. The trestle legs were made 12-in. square throughout, in order to avoid the difficulties and uncertainties of making the reinforced concrete in smaller sections in the long posts.

As the work was extensive it was carefully systematized. The first gang excavated the footings and set the concrete foundation pedestals, followed by the carpenter gang erecting the forms, then the steel erecting gang, and finally the concrete gang. The forms were made as simple as possible to knock down for use again. All steel for the legs was made up in units and erected entire. The concrete gang had a 4-cu. ft. Little Wonder mixer with loading attachment, mounted on wheels. The mix was delivered to concrete buggies, running on the deck of the trestle forms and chuted to place through 10-in. sheet-iron pipes. The concrete trestles with the concrete pipe in place made a fine show and, all in accord with the permanent character of the concrete dams, were particularly pleasing to the city officials and taxpayers.



CEMENT MORTAR TESTS

Full lines indicate briquettes steamed for three hours immediately after mixing.

Dash lines indicate briquettes set in air for three hours after mixing and then steamed three hours.

All briquettes placed in water, one hour after steaming, for remainder of period.

Concrete Pipe

After the failure of the original contractor, the city relet the work of fabricating and laying the 42-in. concrete pipe to the Pacific Lock Joint Pipe Company, of Seattle. Although concrete pipe heretofore had been extensively used in sewer work, no job of like magnitude and difficulty had been undertaken for a water-supply conduit, so that former methods were found inadequate and the new ones initiated by the contractor were gradually changed and sifted down to an efficient system, interesting and productive of excellent results.

The contractor first graded the pipe yard at the foot of the cable incline and adjacent to the wharf at Coopers Cove. An excellent concrete aggregate was delivered in scows from the Albert Head deposit to the Coopers Cove wharf and unloaded into storage by a derrick and grab bucket. Vancouver Island Portland cement was delivered in sacks direct from the mill to storage warehouses on the wharf. A 1:2:4 mix was used for the pipe, with the coarse aggregate limited to ½-in. diameter gravel.

There were 75 sets of forms, with 216 bases for the flow-line pipe having 3-in. shell, and 12 sets of forms with 32 bases for the siphon pipe having 4½-in. shell. All pipe was fabricated in 4-ft. lengths. The reinforcement used in the flow-line pipe was style 6, triangular mesh made by the American Steel & Wire Company, which has 0.043 sq. in. of ring reinforcement in sectional area and 0.025 sq. in. longitudinally per foot of pipe wall. Square steel bars were used for the ring reinforcement of siphon pipe according to Table 1.

Six 1⅜-in. square bars were used longitudinally and the ring reinforcement was spaced by light longitudinal wires, so that it would not be moved when tamping the concrete.

Forms

The inner and outer forms are of 3/16-in. plate. The outer form is in three and the inner in four equal cylindrical sections. On these sections are riveted short angle-iron lugs to hold the spacing and clamping rings that stiffen the forms. The sections of the cylindrical form are held together at the seams by the lap and by short slotted angle-iron clamps that drop over a rivet head on each section of the forms.

The pipe is cast with the bell end down, and to leave the projecting wire for the Merriweather lock joint, the reinforcing ring is set in an annular space of the base plate which is then filled with sand. A separate short reinforcing ring is placed outside to reinforce the projecting bell. A circular sheet-iron plate is placed on the top of the forms on which the concrete is dumped and the tampers stand. The concrete is distributed from the plate to the annular space between the forms by a sweeping push of a shovel. The tamping bars are like heavy hoes with a shank about 4 ft. long and the blade bent in line with the shaft. The tamper puddles the concrete and forces the coarse aggregate away from the forms.

It was found at first that the forms had a tendency to spring at the seams, causing unequal thickness of shell which made offsets at the joints in laying. Various schemes were tried to obviate this trouble and finally light wood cross braces at right angles were used inside the forms, placed against the seams. At the top, bent spacing hooks were hung in the annular space to give the precise thickness of shell. These were removed when the pipe was moved to the steaming shed.

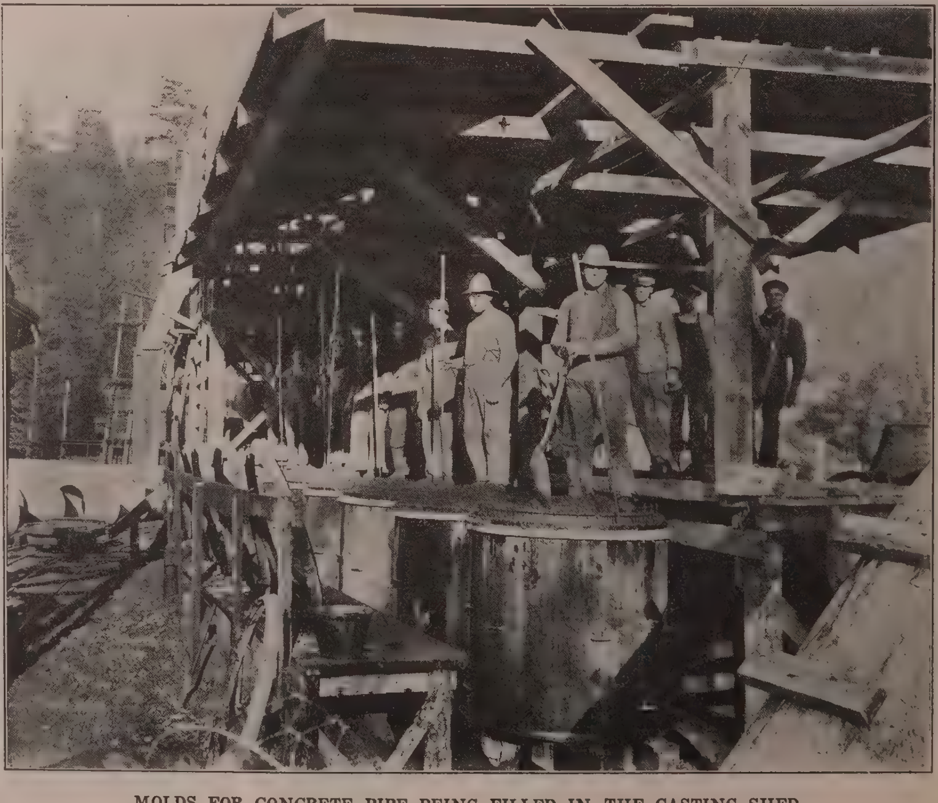
Table 1—Bar Reinforcement for Siphon Pipe

Head, Ft.	Spacing, In.	Size, Sq. Bars, In.
0–20	3½	¼
20–40	3½	⅜
40–60	4½	½
60–80	3½	½
80–100	4	⅝

Three special bevel pipes were used in laying the curves, made by dropping the spigot ring on one side to give ¾, 1½ and 2¼-in. taper in the diameter of the pipe. These bevel pipes made all the curves of the line layout with a limiting bend of 3 deg. at the joints without leaving any appreciable roughness.

Steaming

An interesting and critical feature of the contractor's work occurred in the use of steam for quick curing of the pipe in order to economize in the number of forms and yard space. In the first layout of the plant, separate mixers were used at three points, fed by scoop measuring barrows with sheet-iron partitions. The mixed concrete was wheeled up an incline to a platform along which at right angles ran the movable platform on rails, high enough to pass over the forms. Canvas tarpaulins, fitting over four pipes, were then placed and steam allowed to leak from perforated pipe under this hood for about 2½ hr., when the pipe was dumped off the base and rolled out in the yard on plank runways to cure. The steaming temperatures ran up to 180 deg. Fahr. or more, which, at times, caused



MOLDS FOR CONCRETE PIPE BEING FILLED IN THE CASTING SHED

AMPLE SPACE WAS PROVIDED FOR CURING THE PIPE SECTIONS

trouble, as the heat from the chemical action of setting tended to boost the temperature over the boiling point. A drawing herewith shows the characteristics of steam briquettes. These early methods led to a large number of cracked pipes being culled by the inspectors.

CENTRAL MIXING PLANT

With the advent of a new superintendent, the plant layout was remodelled, making a central mixing plant (see drawing) with three mixers under storage bins at the wharf. These fed measuring boxes that were tipped into the mixers. Adjacent to the mixer plant was the mixing platform with tracks on both sides, on which were placed the flat cars carrying the forms. The tampers worked on each side of the platform alternately. As the molds on one side were full, the cars were hauled into the first steaming shed and given 3 hr. steaming with the forms on, then hauled out to the stripping platform at the far end where the forms were stripped. The pipe, setting on its base on these cars, was then hauled into a second shed and steamed for about 4 hr., after which they were lifted off their bases by a chain block traveling on a light gantry crane. The cable from the hook of this block passes through sheaves at the ends of a sheet-iron band for lifting and tilting the pipe on the side for rolling out in the yard.

The new scheme of work produced good results and the number of culls was very small. The surface of these pipes was very smooth. At times there was small pitting, the cause of which remained obscure, although the subject of wide speculation. It apparently was due to some obscure conditions of the oil used in coating the forms in combination with temperature conditions and other factors. They appeared and disappeared without any definitely assignable reason. This effect was generally negligible. A little thin mortar was at times wiped into them if they were too noticeable. Generally, "skid" oil was used in wiping the forms, although other combinations were experimented with to stop the pitting. After curing in the yard two weeks or more, depending on the degree of cold, the pipe was rolled to a chain block gantry and loaded onto flat cars with longitudinal pillow slats on the side built up to conform to the curve of pipe.

TRANSPORTATION

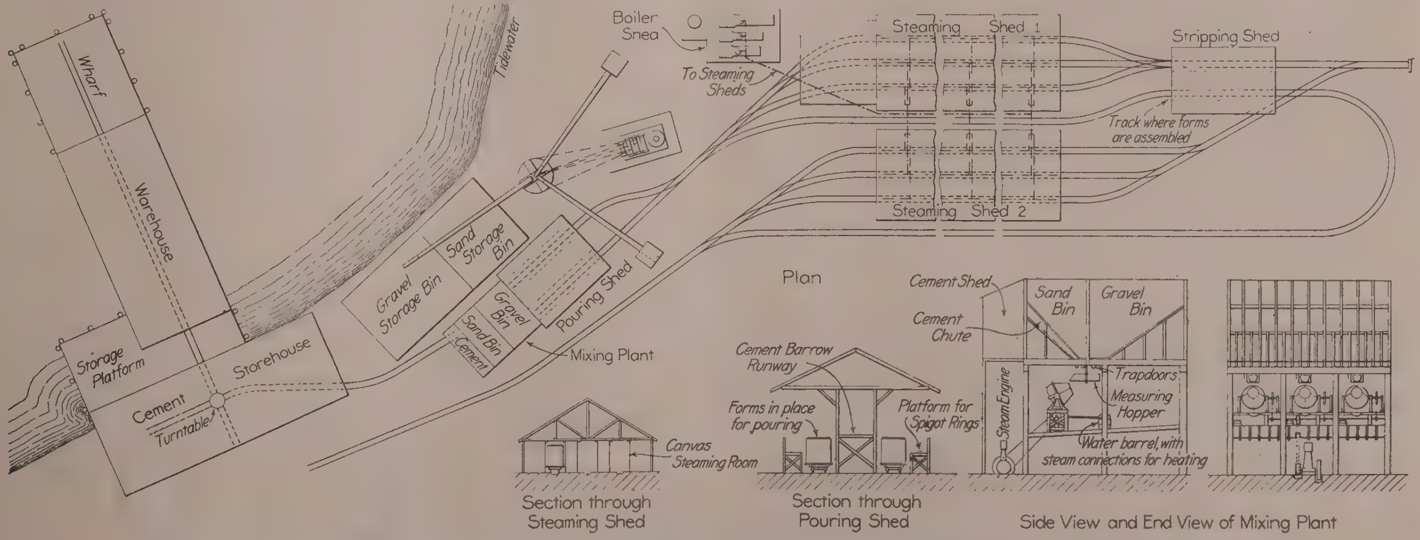
In the early stages of the work, when the contractor was looking for the causes of the culls, various methods of padding the pipe against shock in transportation were used. The trouble, however, was due generally to inadequately cured pipe, damaged by handling in the yard. It was realized later that there were no transportation troubles with well-fabricated and cured pipe. From 150 to 160 four-foot sections of pipe were made each 8-hr. shift.

From the Coopers Cove yard at the head of the incline the pipe trains were run each way to the end of track and unloaded onto the ties, after the rails were taken up, by chain blocks hung from pipe tripods. The pipe was rolled to place at the end of the conduit along the ties laid end to end along the grade.

LAYING

Various attempts to use an overhead trolley system for laying the pipe were disappointing, chiefly because of the numerous curves in the line, and a pipe tripod with a chain block having a long horizontal pipe-laying hook was finally used. This hook worked well on the straight pipe but too much time was lost in fitting the specials to place, as they generally had to be revolved on their axis to match the bevels. A suggestion of the consulting engineer, Mr. Meredith, to use rollers on a rod in the hook, operated by a handle, was tried, expediting the laying and giving better jointing. The pipe was lined in by the foreman approximately to the center line. Each pipe section was set to grade by a levelman and held in place while being tamped up tight with ballast bars. A hole was broken in the top of the pipe shell for pouring in grout. Back of the pipe-laying gang, thin flat jointing bands, 6-in. wide, were placed over the inside of the joints of the pipe and expanded to place by a cam lever. The invert part of the jointing had to be put in by hand as the grout would not run across it. Grout was then poured in from a coal scuttle back of the bands and allowed to set. When the liquid was removed, the joint work was scraped and plastered.

Laying the six siphons with 4½-in. shell pipe introduced no exceptional features.



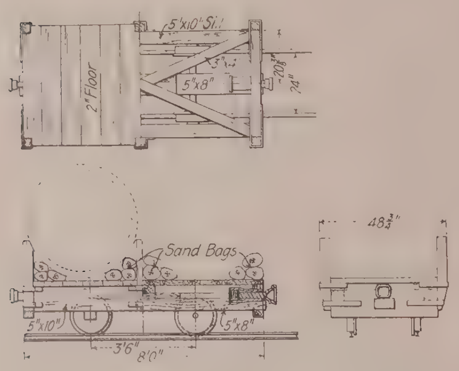
PLANT FOR MAKING CONCRETE PIPE WAS CHARACTERIZED BY ROUTING ARRANGEMENT WHICH AVOIDED DELAYS

Skid timber tracks were laid down the slope on which the pipe section, mounted on sleds, were skidded to place. Small guyed shear-legs were used in jointing the pipe. All siphons were anchored heavily at the foot of the inclines on either side of the valley to prevent creeping downhill. An interesting feature of the trestle design at the siphons and elsewhere was the use of saddle blocks with a grouting recess. These blocks were tied together by long rods and were free to move on the concrete crossbeams to accommodate temperature movements.

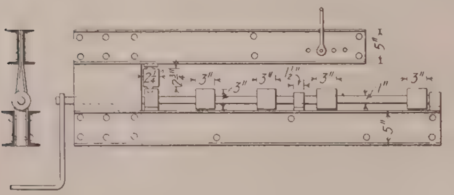
OBSERVATIONS ON MAKING AND LAYING LOCK-JOINT CONCRETE PIPE

These observations on the making and laying of lock-joint concrete pipe may be of service to others having it to do.

Manufacturing.—First see that the forms are well cleaned, then well oiled with a mixture of about one-half green skid and one-half black oil. Be careful that this coat of oil is thin enough, but not too fluid. See that the forms are set perfectly cylindrical and well braced to remain true when concrete is tamped in them. See that the shell space is of even thickness on all sides, and that the form sits properly on the base so that the bell is of even thickness on all sides. See also that the spigot rings are properly placed so that the spigot is of even thickness on all sides, and that the lock-joint mesh projects its proper distance in both the bell and spigot, so as to avoid trouble in laying.



SMALL CARS TRANSPORTED THE PIPE SECTIONS ALONG THE GRADE



THIS HOOK ALLOWS PIPE TO BE LIFTED AND TURNED ABOUT ITS AXIS SO TOP IS UP

Pour a small batch of mortar first, continuing with the regular concrete mix to the last foot at the top, and then stiffen the mixture. The concrete should be extra well tamped or puddled to eliminate air bubbles and secure an extra smooth surface. When pipe is steam cured about 135 or 150 deg. is the most satisfactory temperature. Steam about 3½ hr., then strip the forms and steam again for 3½ hr. This applies to a 3-in. shell; the time would vary with the thickness of shell. When steam cured pipe should be kept well sprinkled and not laid until it is at least two weeks old. The required time of curing varies with the temperature.

In removing the pipe from bases it should be raised vertically about 1 in. and the base should be jarred loose by tapping evenly on opposite sides, after which the pipe can be raised up by the chain blocks until it clears and then turned over on its sides and rolled to the yard for curing. See that the bell and spigot are properly curved to avoid breakage.

Laying.—The pipe should be carefully laid to the proper grade and set with a Wye level, and the general alignment should be kept as near as possible to the exact center line of the grade.

Care must be taken that the pipe is well packed under the full half circle when laid in trench and backfilled. When laid without backfill the full under quarter circle must be well packed with ballast. See that the part directly under the pipe is well filled and tamped, leaving no vacant spaces.

On the inside the pipe must line with each other perfectly at the joints to prevent roughness of the inside surface, which would affect the flow. If there are any irregularities in the pipe circumference these should be laid on top where they will cause the least resistance to flow.

Jointing.—Joints should be well pointed up on the outside at least 24 hr. ahead of pouring. They should be well cleaned, washed out and wet down with water before pouring concrete. The locking wires must be well straightened out in place. Care must be taken that they have their proper lap. When the wires are too long and will not properly lie flat in the bell they should be cut loose from the head wire and wound around it at the proper distance. Wires should extend as near perpendicular as possible from the spigots and bells. Where loose ballast is used and the pipe cannot be pointed on the under side the bottom quarter of the joint can be put in with a stiffer mortar and worked down in place to insure getting it well in between the spigot and bell and leaving no voids or loose mortar.

The inside band form is then placed, the sides well clayed up to prevent leakage. The joint is poured with a sloppy mortar that will readily run into place. This should be puddled with a soft No. 8 wire to insure its settling. As soon as the joint is set sufficiently remove the band and scrape down the joint until it is slightly below the surface of the pipe. Then wet the joint down and plaster a thin coat of neat cement over it until it is a trifle above the surface of the pipe, leaving the cement to set until it is fairly hard. Then scrape the plaster down even with the surface of the pipe, and rub well with a coarse sack or brush. If the pipe is a little hollow on the side of the joint the plaster should not be permitted to run out over the smooth surface of the pipe.

In making pressure joints the smooth surface of the pipe should be chipped off for about 1½ in. each side of the joint and about ¼ in. deep before the joint is poured. The joint must not be filled beyond the chipped part. After the joint sets the entire recess is filled with a neat cement plaster a little above the surface of the pipe and then scraped off and finished the same as the regular joints.

The pipe should be well cleaned of all construction dirt and waste, as there is usually enough unset cement in this refuse to make it adhere to the bottom of the pipe.

TABLE 2—COSTS OF CONSTRUCTING 42-IN. CONCRETE PIPE LINE

Earth Excavation, Flow-Line Grade (128,590 Cu. Yd.)

	Per Cu. Yd.
Labor	$0.543
Materials	0.036
Camp	0.011
	$0.590

Rock Excavation, Flow-Line Grade (141,647 Cu. Yd.)

	Per Cu. Yd.
Labor	$1.24
Supplies	0.46
Camp	0.09
	$1.79

Concrete Trestles, Flow-Line,
1120.67 Cu. Yd. Concrete; 93,700 Lb. Steel Rods

	Per Cu. Yd.
Cement	$3.50
Sand	1.70
Gravel	3.20
Steel	2.80
Forms	10.09
Mixing and placing	3.14
Placing steel	1.21
Moving plant	1.16
Cleaning up	0.65
Sum	$28.68
Excavating footings	2.20
	$30.88

Two-Ft. Gage Track, 20-Lb. Rails

	Per Mile
Rails	$1,513.00
Laying	348.00
Ties	171.00
Ballast	318.80
Plant charge	240.70
Material	129.60
Camp	100.90
	$2,722.00

Reinforced-Concrete Pipe,
42-In. Diameter; 3-In. Shell; 144,000 Ft.
(From engineers' cost accounts)

	Per Ft.
Fabrication	$0.7529
Material	0.8294
Laying	0.4168
Hauling	0.3062
Construction railway	0.859
Sum	$3.1643

Table 2 gives the cost of the pipe line work, taken from the records kept by the engineering force.

PERSONNEL

The work was done under the direction of C. H. Rust, M. Am. Soc. C. E., city engineer and water commissioner of Victoria. Wynn Meredith, a member of the firm of Sanderson & Porter, of New York and San Francisco, was consulting engineer, and the writer was resident engineer.

TURBULENCE EFFECTS REAERATION of streams with depleted oxygen content, and several "boils" or mere overturns are considered more efficient than a single large fall. The conclusion is one reached from the investigations now being made by the U. S. Public Health Service on the Ohio River. Reaeration is conditioned among other things upon the degree of turbulence of the stream. In quiescent water a diffusion gradient is established which practically stops reaeration. The effect of dams and rapids in increasing aeration is not so much dependent upon the momentary exposure of the water but is largely due to the mixing action whereby the diffusion gradient is broken up and reaeration permitted to proceed. In artificial canals turbulence is avoided as largely as possible. The effect of a single dam upon reaerated water has been shown to be equivalent to a large increase in initial dilution. Where dilution is for any reason limited, the capacity of sluggish and non-turbulent streams can be greatly augmented by providing an artificial turbulence at certain points in their course. Such turbulence need not be of the character of a fall, nor need it cause a serious loss of head.

How Shall Patented Materials or Processes on Public Works Be Handled?

George C. Warren Takes Issue with Views of S. Whinery as Expressed in Recent Article in Engineering Record—Mr. Whinery Replies

IN the Engineering Record of July 17, page 73, there was published an article by S. Whinery, consulting engineer, of New York City, dealing with the relations of contractor, State or city and patentee of materials or processes used in public works construction. Mr. Whinery called attention to abuses existing under present conditions, where the contractor deals directly with the patentee, and, as a remedy, advocated the payment of all patent royalties by the State or city. To Mr. Whinery's proposal, George C. Warren, president of Warren Brothers Company of Boston, which controls the patents for Bitulithic pavement, has taken exception. Mr. Warren's communication is given below and is followed by Mr. Whinery's reply.—EDITOR.

George C. Warren's Letter

The full text of Mr. Warren's letter follows:

"In an article on patented processes and materials in public work, published in the Engineering Record of July 17, page 73, S. Whinery makes the points briefly outlined as follows:

"1. Forcefully outlines the inherent right of the patentee to the monopoly of his invention: 'An invention protected by a patent is as much the property of the patentee as his real estate or his chattels. Neither his neighbor nor the public may deprive him of such property, nor can the State appropriate or use his invention without his consent.'

"2. Properly objects to the patentee having a monopoly, through his patent, of portions of the general construction not covered by the patent. This objection is overcome by the Bitulithic license mixture agreement invariably filed with all municipalities desiring to lay the Bitulithic pavement, offering to deliver that portion of the pavement covered by the patent; i.e., the Bitulithic surface mixture, manufactured and delivered hot at the mixing plant of the patentee, at a uniform price to any contractor who may desire to bid on the contract as a whole.

"3. Outlines a danger of fixing in advance a price for the patented article that the patentee is not a party to the paving contract and is not required to furnish material under certain specifications.

"In the case of Bitulithic license mixture agreement this danger is overcome because that agreement provides that the material shall be manufactured according to the specifications of the paving contract, just as the manufacturer of paving brick, although not a party to the paving contract, is required to manufacture and furnish product in accordance with the specifications thereof, the only difference in this respect being that in the case of Bitulithic the municipality makes a definite binding contract for the manufacture with the party who is most experienced, most responsible and most interested to accomplish success in the manufacture of that particular article; i.e., the owner of the patent, whose very existence depends on integrity of result.

"4. Recommends that the State or municipality, as the case may be, contract direct with the owner of the patent for the use of the patent on a royalty basis.

"Mr. Whinery overlooks the facts that:

THE "FLAT ROYALTY" BASIS

"A. It seldom happens that any patent is successfully developed on a 'flat royalty' basis, and this is especially true when the patent covers a manufactured product requiring skill, experience, heavy plant investment, technical knowledge, and, last but not least, an inherent interest vital on the part of the manufacturer in the success of the product.

"In many cases the inventor personally receives only a fixed royalty but almost invariably in such cases he has surrendered the right of manufacture to one or more parties equipped to properly handle the development and they are granted, by the inventor, the right of manufacture and sale, which the Government has bestowed on the inventor. If there has ever been a case of successful development under any patent on the basis of the inventor surrendering his right of manufacture to the public on a 'flat royalty' basis, we have never heard of such a case. On the other hand, it can be readily shown that in the case of municipalities which have insisted on such surrender of right of manufacture to the public and the demand has been locally acceded the development under such license has been either nil or the results very unsatisfactory to the public.

"It is very certain that in the case of the Bitulithic pavement it would have never even secured a successful start and would have 'died a-bornin' if its manufacture was subjected to the ruinous competition of either inexperienced manipulators or the powerful competitive interests which, as it is, have expended hundreds of thousands of dollars in every conceivable way, however unfair, to defeat and prevent its success.

SUCCESS OF INVENTIONS

"B. To make a success of a new invention requires the combined and constant application of financial interest and investments; sacrifice of time and ability, and absolute faith in and desire for final success, notwithstanding many discouragements which are certain to come, however little they may be foreseen and however much they may come from unanticipated sources or causes.

"All of this is well recognized in the Federal constitution and laws with respect to patents, in giving the patentee the 'exclusive right of manufacture and sale' for a period of seventeen years—a period which the law contemplates is sufficient to enable the patentee to overcome such obstacles, perfect his invention and give him a reasonable opportunity for return for the valuable product of his 'brain and brawn' which after the brief period of seventeen years, he dedicates to the public.

"C. However important may be the question of ultimate competition in the manufacture of the patented article the fostering care of the Government during the period of development and discouragement is vastly more important and is well recognized by the patent laws of every civilized government of the world, which has made any substantial progress in development during the past two centuries. In no case does any considerable portion of the public object to the operations of a patent during its development stage—the period of anxious worry on the part of the patentee. It is only after the patentee or his licensees have invested their capital and energy at great risk and have proved the practical success of the article and begin to get returns on that investment, that a portion of the public reach a period of thought that the patent is iniquitous, that there is nothing new or patentable in the 'so-called invention,' and that the public always has used the invention now so common and well understood. Such thought on the part of a minority is almost universally engendered by the competitors of the patented article, who would not have been willing to take the necessary risk of development, but, at this stage of proved utility and success, chafe under the conditions that they are not reaping any part of the advantage which the Government has granted to the inventor.

TROUBLE IN STATE PARTICIPATION

"Mr. Whinery's suggestion that the State pay a royalty per unit, and that the patentee himself can bid with other contractors on the same basis for the work, carries with it more trouble than the present method of a license agreement and at the same time does not improve the condition. Assuming that a certain royalty has been arranged with the State, the amount of this royalty is just as much subject to favoritism on the part of the patentee as it is if the royalty is simply paid by the contractor or included in the price paid for the manufactured patented article. Furthermore, the State may accept a royalty and not specify the material at all, thus entirely excluding the patentee's profit, or the contractors may, in order to defeat the patentee, refrain from bidding on such patented construction unless the patentee is permitted to protect his interest by himself bidding for the whole work.

"A State royalty, strictly speaking, does not put the contractor on equal basis with the patentee for the patentee can always be willing to take less profit than the actual royalty which will have to be paid by the contractor and thus secure the work. It stands to reason, however, that the contractor is not going to forego his assured income from royalty and bid less than a reasonable profit for the completed work. Consequently there is an equitable basis of competition between the general contractor and the patentee if the patentee elects to bid for the construction in which his patent is used.

"The courts have decided this question as shown by the following extract from decision of the Supreme Court of Louisiana:

" 'Where such a document is filed all prospective bidders are placed on the same footing, and the situation is precisely the same as if a patented process did not have to be used, except that 25 cents per yard additional must be figured into the cost of fulfilling the contract. But all competitors are under the same necessity of making this addition to their estimate, and hence no inequality is created.'

"Again a competitive contractor may purposely lay bad work in order to destroy the good name of a patented construction or he may not have the necessary skill and experience to insure high grade construction. The only adequate protection that the patentee has is to supply the material to all responsible contractors at a fixed reasonable price and have the same manufactured under their direction."

S. Whinery's Reply

A copy of Mr. Warren's letter was submitted to Mr. Whinery, whose reply follows:

"I am pleased to have the opportunity to read and comment upon the communication from George C. Warren, relative to the article prepared by me on the subject of the use of patented materials and processes upon public work. The purpose of that article was to consider and suggest a preventive remedy for the abuses that have crept into the practical use of patented articles and processes upon public work, and especially upon road and pavement work.

ABUSES EXIST

"Mr. Warren's comments on the article are in the nature of a plea for patentees in general, with special reference to one patented pavement. That the abuses, some of which I referred to in my article exist, no one will deny. There are unscrupulous and dishonest as well as honest patentees and contractors, and the public officer must guard the public against the machinations of the former class, even though some hardships result to the latter. (Here, as in the previous article, I use the word 'patentee' as embracing his agents, licensees or assigns.)

"By far the most important, because the most serious in results to the public, of these abuses is the practice, under cover of patent rights, of the patentee himself, or in collusion with unscrupulous contractors, extorting excessive and unreasonable prices and profits from the public, by well known schemes outlined in my article. Mr. Warren does not allude to this phase of the subject, though it must have been in his mind. It would be interesting to know his views about it, and whether he has an effective remedy to suggest.

FILING OF PRICE INEFFECTUAL

"It is certain that the public filing of a price at which a patented article will be supplied to all contractors is ineffectual unless some way can be devised to insure that the price named is a minimum, or that will prevent the patentee from secretly naming to a favored contractor a price so much below that publicly named as to give that contractor a controlling advantage in bidding, if not to create a real monopoly. Had the Court, whose opinion Mr. Warren quotes, been advised of the fact that this device of naming a price for all contractors is, in fact, often successfully used to defeat its avowed purpose, the decision would probably have been different.

"Mr. Warren expresses the opinion that the remedy proposed by me—the payment to the patentee directly by the State of an agreed upon royalty—would lead to more trouble than does the present practice, intimating that the royalty received might be shared with a favored contractor. It is difficult to understand what benefit the patentee could derive from such a division of the royalty; presumably the work would be awarded to some contractor and the patentee would get the full royalty. Furthermore, competent officials would not agree to pay a royalty so excessive that the patentee could afford to divide it with any contractor, or which, if so divided, would materially affect the prices bid.

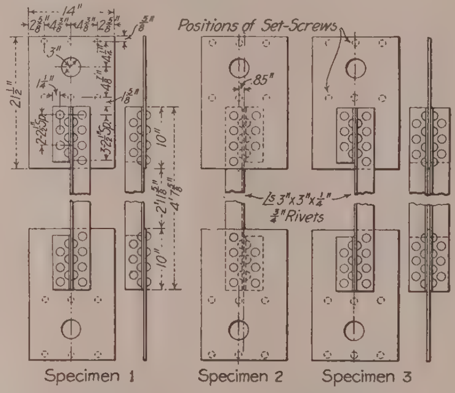
"If Mr. Warren, in the paragraph marked C, really means to say that the public should submit to being defrauded by unscrupulous patentees and contractors in order to afford opportunity for the development of any invention, however important, few will agree with him. In so far as he urges such fair, just and even liberal treatment for the patentee and his inventions as is consistent with the public welfare, no right-minded person should disagree with him."

[*In an early issue the phases of this subject, as they relate to patents for concrete bridge construction, will be discussed by Daniel B. Luten, with a reply by Mr. Whinery.*—EDITOR.]

Tests Prove Lug Angles Valueless for Insuring Uniform Stress Distribution

Measurements of Variation in Strain Across Single and Double Angle Specimens Under Tensile Stress Reported by Professor Batho

THAT LUG ANGLES for the end connections of angles to gusset plates really serve very little useful purpose and that the slight effect which they have cannot be predetermined is one of the conclusions reached by Cyril Batho, assistant professor of applied mechanics, McGill University, Montreal, as the result of a series of tests reported in a paper in the August issue of the *Journal* of the Franklin Institute. The simplified form of mirror extensometer used gave results of great uniformity and accuracy, reading to 0.00001 in. He concludes that the usual assumption of planar distribution of stress is justifiable for such members as were tested, and that the ordinary theory may be applied to an analysis of stress distribution across such members.



SPECIMENS USED IN EXPERIMENTS

Reference is made to a previous paper by the author published in the *Transactions* of the Canadian Society of Civil Engineers, Vol. 26, page 224, and to the theory of eccentric stress developed by Prof. L. J. Johnson in the *Transactions* of the American Society of Civil Engineers for 1906, page 169. The tests reported by Professor McKibben in the *Proceedings* of the American Society for Testing Materials, Vol. 6, page 267, and Vol. 8, page 287, are cited as showing similar results for the effect of lug angles when such tension members are tested to the breaking point.

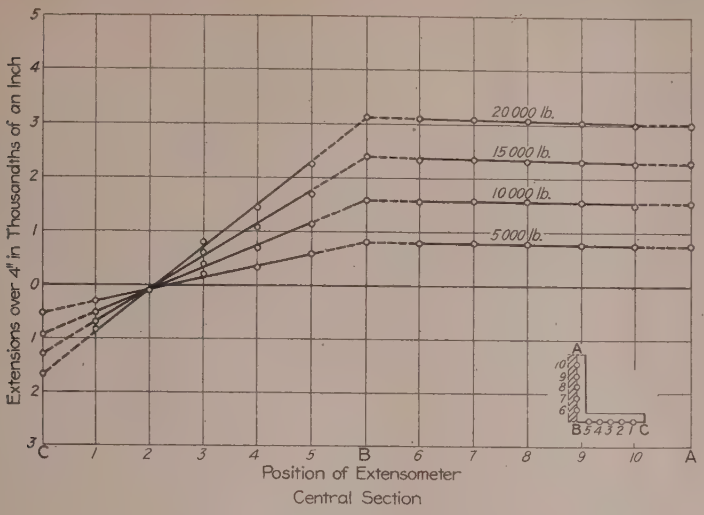
The condensed abstract which follows gives a description of the tests and principal conclusions reached by Professor Batho, but omits the extensive theoretical discussion. The essential variation in these experiments from the similar series previously made at the McGill University laboratory is in the use of special grips made to afford restraint for the end gusset or connection plates to which the load was applied. The chief object, however, was the investigation of the effect of lug angles.

TEST SPECIMENS AND MEASURED STRAINS

Experiments were made on three specimens, two single-angle members and one double-angle member shown in the accompanying drawing. All were the ordinary shop product made by the Dominion Bridge Company of Montreal, and the angles were of uniform sections, 3 x 3 x ¼ in. The end

TABLE 1—STRESSES CORRESPONDING TO MEAN EXTENSOMETER READINGS FOR SPECIMENS WITHOUT LUG ANGLES

	Total Load, Lb.	Stresses in Lb. per Sq. In. at Points									
		1	2	3	4	5	6	7	8	9	10
Specimen 1—Area 1.60 Sq. In. E = 29,100,000											
Central section	5,000	—2,030	—580	1,380	2,690	4,290	5,750	5,680	5,600	5,530	5,390
	10,000	—3,640	—730	2,760	5,390	8,440	11,490	11,490	11,330	11,200	10,830
	15,000	—4,940	—800	4,290	8,000	12,420	17,000	17,000	16,880	16,800	16,380
	20,000	—6,030	—730	5,810	10,690	16,420	22,470	22,400	22,240	22,240	21,780
Section 2½ in. from end plate	5,000	—2,690	—870	650	2,260	4,290	5,750	5,670	5,600	5,520	5,380
	10,000	—5,390	—1,960	1,530	4,510	8,440	12,160	12,220	12,380	12,720	12,720
	15,000	—7,930	—2,620	2,470	6,840	12,420	18,180	18,270	18,320	18,920	18,990
	20,000	—10,100	—3,270	3,640	9,240	16,420	24,210	24,280	24,210	24,850	25,100
Specimen 3—Area 3.08 Sq. In. E = 30,100,000											
Central section, left....	15,000	4,220	4,360	4,660	4,890	5,190	5,340	5,410	5,260	5,190	4,960
	20,000	5,650	5,850	6,320	6,470	7,000	7,070	7,150	7,070	7,000	6,760
	25,000	7,070	7,380	7,830	8,050	8,650	8,880	8,950	8,880	8,800	8,500
	30,000	8,430	8,880	9,410	9,860	10,390	10,600	10,680	10,600	10,530	10,380
Central section, right..	15,000	3,990	4,510	4,890	5,260	5,790	5,650	5,490	5,120	4,820	4,440
	20,000	5,340	6,020	6,550	6,920	8,280	7,670	7,230	6,920	6,400	6,020
	25,000	6,780	7,450	8,200	8,730	9,480	9,480	9,180	8,580	8,050	7,520
	30,000	8,130	8,950	9,790	10,430	11,410	11,420	10,990	10,220	9,860	9,180
Section 2½ in. from end plate, left..	15,000	3,080	4,280	5,420	6,170	6,620	6,320	5,640	4,960	4,580	3,980
	20,000	4,290	5,720	7,150	8,280	8,730	8,420	7,680	6,770	6,090	5,340
	25,000	5,340	7,220	9,180	10,300	10,990	10,460	9,470	8,570	7,670	5,690
	30,000	6,620	8,740	10,900	12,490	13,220	12,500	11,500	10,150	9,250	7,960
Section 2½ in. from end plate, right	15,000	2,860	3,990	5,110	5,800	6,250	5,950	5,560	4,960	4,660	4,220
	20,000	3,990	5,490	6,850	7,900	8,280	7,900	7,370	6,620	6,170	5,650
	25,000	4,970	6,920	8,650	9,780	10,380	10,000	9,260	8,350	7,670	7,070
	30,000	6,100	8,280	10,440	11,890	12,490	12,030	11,200	10,090	9,180	8,500



MEASURED STRAINS AT POINTS ACROSS SECTION OF SINGLE ANGLE WITHOUT LUG ANGLES—SPECIMEN 1

connection plates were 14 x 3/8 in. x 1 ft. 9½ in. long and were restrained from turning by six set screws on each side as indicated in the figure. In order to determine the distribution of stress under different loads at the central cross-sections of the specimens and also at sections near the end plates, extensometers were used with their 4-in. distance pieces set parallel to the axis of pull, so that the strains measured were mean strains over that length. Readings of the extensometers were taken at ½-in. intervals over the outside face of the angles as shown in the diagram, the extensometers being arranged first with the mirror at the lower end and then at the upper end and the mean of these readings taken to eliminate errors due to the bending of the specimen. The uniformity of the results was remarkable. It was found that the specimen could be taken out of the machine and replaced without the extensometer readings for a given loading being appreciably altered.

EXPERIMENTAL RESULTS

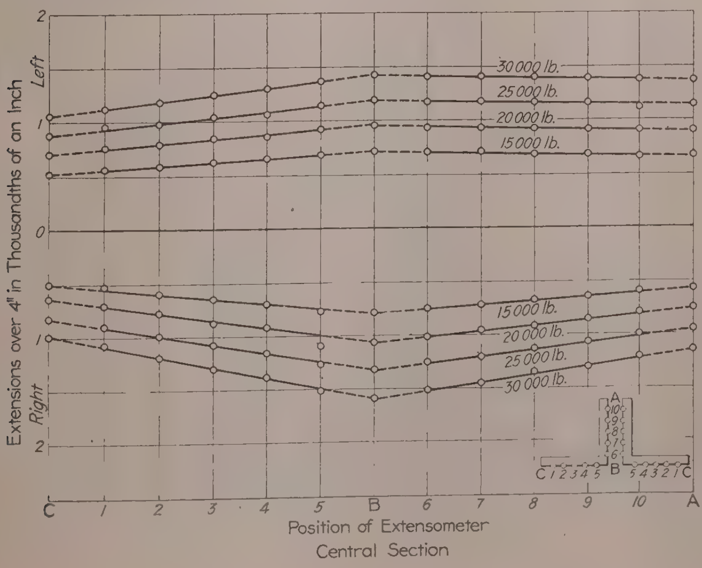
Complete diagrams and tables give the measured strains and corresponding computed stresses with comparisons. The accompanying diagrams and Table 1 for specimens without lug angles indicate the general character of the results. Tension is plus and compression minus. In discussing the restraining effect of the end plates it is pointed out that the restraining couple perpendicular to the end plates is small for the single-angle member, and the specimen may be considered practically free to bend perpendicularly to the end plates. The case of the double angle is quite different. The two angles, back to back, prevent each other from bending perpendicularly to the end plates, and the result is an almost complete fixing in that direction, considerably decreasing the ratio of maximum to mean stress over the section.

TABLE 2—EFFECT OF LUG ANGLES ON RATIO OF MAXIMUM TO MEAN STRESS AT CENTRAL CROSS-SECTIONS

Total Load, Lb.	Specimen 1			Specimen 2		
	Ratio of Maximum to Mean Stress		Per Cent Change Due to Lug Angle, Increase	Ratio of Maximum to Mean Stress		Per Cent Change Due to Lug Angle, Decrease
	With Lug Angle	Without Lug Angle		With Lug Angle	Without Lug Angle	
5,000	2.08	1.96	6.1	1.95	1.95	0
10,000	2.05	1.86	10.2	1.83	1.93	5.2
15,000	2.00	1.82	9.9	1,82	1.90	4.2
20,000	1.94	1.79	8.4	1.78	1.83	2.7
	Specimen 3					
	Double Angle, Left			Double Angle, Right		
			Decrease			Decrease
15,000	1.06	1.11	4.5	1.19	1.22	2.5
20,000	1.06	1.11	4.5	1.19	1.24	4.0
25,000	1.05	1.10	4.5	1.18	1.23	3.2
30,000	1.05	1.10	4.5	1.18	1.23	3.2

There is a fair agreement between the results for specimen 1 and specimen 2, although the line of pull on the end plate is different in the two cases, being shifted to the center of gravity of the angle in specimen 2.

It is often asserted that lug angles considerably reduce the ratio of maximum to mean stress in the member, some authorities going even so far as to say that when a lug angle is used the stress is practically uniformly distributed. A glance at Table 2 will show how far this is from the truth. The ratio of maximum to mean stress in specimen 1 is actually greater by about 8.4 per cent with the lug angle than without it. In the case of the double angle the stress in one leg is decreased about 4.5 per cent and in the other 3.2 per cent. It is thus evident that the effect of the lug angle is very small, and that the angle is practically worthless for the purpose of distributing the stress more uniformly. It thus appears that lug angles are of very little



MEASURED STRAINS AT POINTS ACROSS SECTION OF DOUBLE ANGLES WITHOUT LUGS—SPECIMEN 3 practical value and are unnecessary, expensive and cumbersome additions to the end connections.

Summary and Conclusions

The chief conclusions of the author are:

1. That the only practicable experimental method at present available for investigating the distribution of stress in built-up members is by means of some form of extensometer, and that the simplified mirror extensometer used in the tests described is very suitable for this purpose. (This instrument is described in the article which follows.)
2. That the assumption of a planar distribution of stress is justifiable in such members as are considered here, except perhaps close to the end connection, and that the ordinary theory may therefore be applied to an analysis of the distribution of stress in these members.
3. That in single and double-angle tension members connected at their ends by means of rivets to wide and rigidly held gusset plates the stiffness of the gusset plate in its own plane has a considerable effect on the distribution of stress in the member.
4. That in such members lug angles are of very little, if any, value for the purpose either of giving a more equable distribution of stress in the member or of increasing the effective length of end connections.
5. That a slight change in the line of application of the load to the gusset plates does not materially affect the distribution of stress in the member, except possibly close to the end connection.
6. That the experiments on double angles bear out the theory that such members do not act as a single piece bending as a beam.

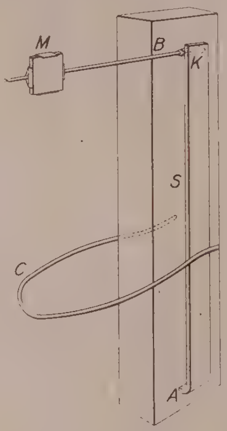
Simplified Form of Mirror Extensometer Developed

Professor Batho Describes a Simple and Accurate Instrument Used at McGill University Testing Laboratory

THE RECENT development in the field of direct measurement of local stress variations by means of extensometers has been notable. The modified form of the Marten's type of instrument as used, designed and constructed in the McGill University Testing Laboratory is described by Professor Batho in the article on tests on lug angles in the August issue of the *Journal* of the Franklin Institute. These instruments have been proved capable of giving very accurate and uniform results.

The principle of the instrument is shown in the accompanying figure. It consists essentially of a double knife edge, *K*, which fits between the specimen under test, and a V groove in one end of a steel strip, *S*, which is in contact with the specimen at *A*, and is pressed against it by means of a clip, *C*. The change in the length of the specimen between *A* and *B* causes the knife edge to tilt, and the tilt is measured by means of a telescope and scale, the scale being reflected in a mirror, *M*, attached to the knife edge.

In the actual instrument the steel strip is ⅜-in. wide and ⅛-in. thick, the length *AB* being chosen to suit requirements. The end *A* is turned at right angles and brought to a sharp edge so that it may not slip on the specimen. The knife edge is of hardened steel about 0.18 x 0.12 x 0.45 in., and the mirror is attached by means of a piece of steel knitting needle. The mirror is held in a clip of thin sheet steel which is arranged so that it can slide and rotate on the needle, a thin copper strip protecting its back from injury. This clip permits of a small amount of lateral adjustment. The mirror is about ½ in. square and must be as truly plane as possible, as otherwise there will be an error introduced when the image of the scale moves to a different part of its surface, as it must do if the specimen deflects at all during the test. It is estimated that the instrument reads accurately to 0.00001 in.



The kind of telescope used affects greatly the facility with which readings may be taken. The McGill University Testing laboratory telescopes are adjustable vertically and horizontally, besides moving bodily about a vertical axis. They are carried on specially made stands permitting any kind of adjustment to be made with ease. If the direction of *AB* remains unchanged during test, the difference of the scale reading between two loads will be an accurate measure of the strains for the given-load difference, but if *AB* alters in direction this will not be the case. If, however, two readings are taken, one with the extensometer in the position shown and the other with the knife edge at *A* and the sharp edge of the strip at *B*, the mean of the two will be correct.

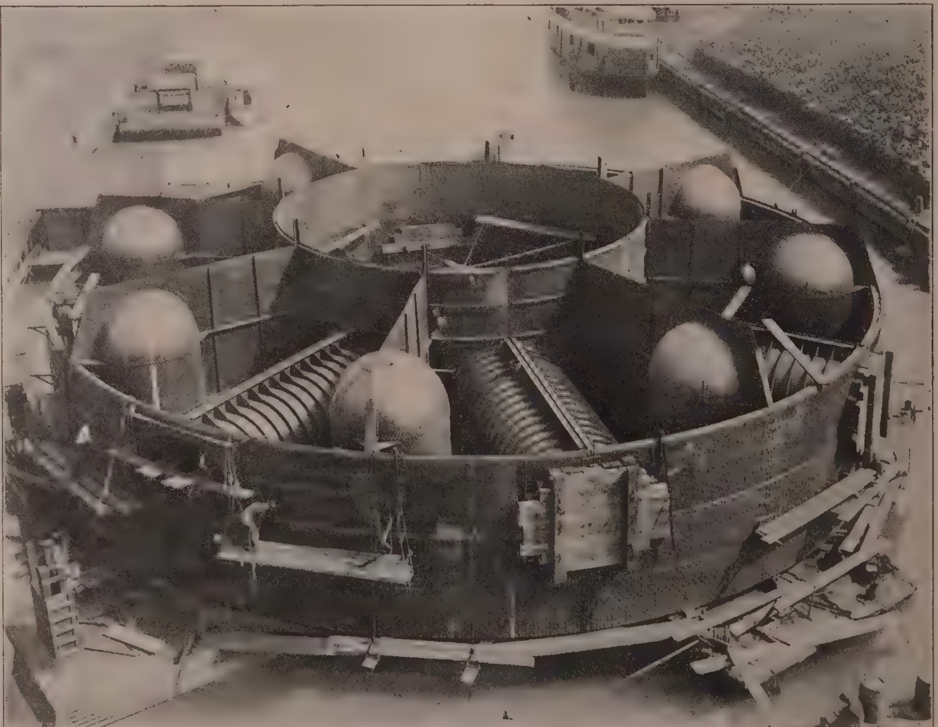
In the opinion of all who have worked with these instruments they are the most simple, practical and accurate extensometers in use.

Shell for Wilson Avenue Crib Floated to Place

THE steel shell for the substructure of the Wilson Avenue tunnel, which was launched on its own flotation chambers Aug. 14, is shown in the accompanying photograph. The shell was supported on scows with its eight buoyancy chambers in place, and men are seen at work bulkheading the intakes which are essential to provide a sufficient air column to keep the shell afloat when the remainder of the steel has been placed. As shown in the drawing of the shell in the Engineering Record Jan. 23, page 103, the straight portion is 17 ft. high, but the shell height is to be increased 28 ft. by an inclined deck.

Erection of the shell was started on a long scow as a backbone and four flotations pontoons, two arranged on each side, making a double cross. The scow is 106 ft. long, 26 ft. wide and draws 7 ft. of water. The pontoons are about 15 x 30 ft. in plan. To remove the scow and pontoons the crib was towed out beyond the mouth of the Chicago River into the outer harbor where the water is 25 to 30 ft. deep. Here the scow and pontoons were filled with water and then pulled out with a tug. The decks were prepared with inclined boards to facilitate this action. The shell sank to a depth of about 11 ft., the water rising to a point about 1 ft. below the top of the intakes. The shell was then towed back to the slip.

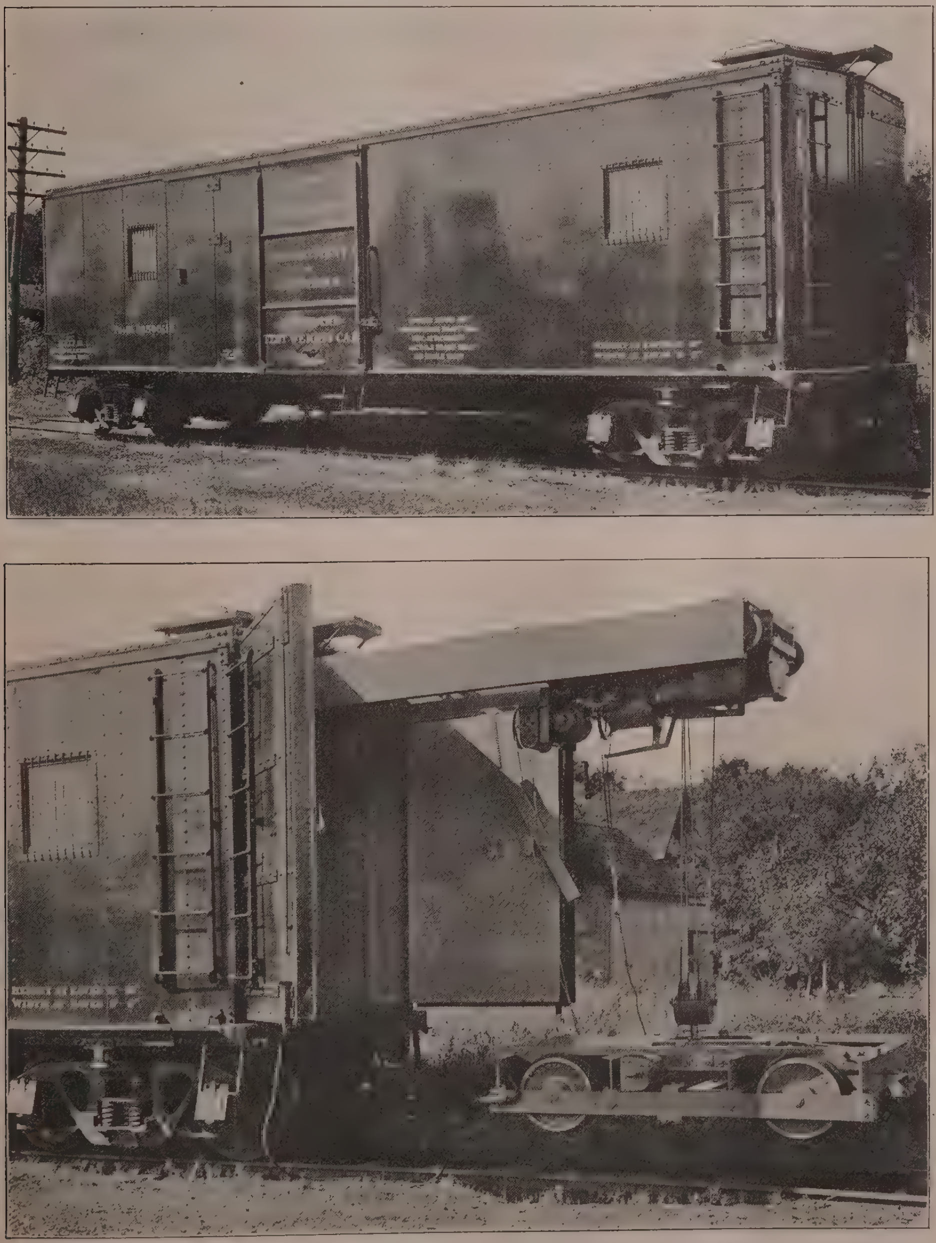
The Fitzsimons & Connell Dredge & Dock Company has the general contract for the construction of the crib. The Ketler-Elliott Erection Company is erecting the steel work which is 80 per cent completed and is furnished by the Chicago Bridge & Iron Works. The design of the tunnel system to the crib was made under the direction of John Ericson, city engineer, M. B. Reynolds, engineer of waterworks design and H. S. Baker, assistant city engineer. All construction work is under the immediate supervision of Henry W. Clausen, engineer of waterworks construction.



PLACING BULKHEADS IN INTAKES OF CHICAGO CRIB FOR WILSON AVENUE TUNNEL

Pennsylvania Builds New Scale-Testing Car for Government

ACCOMPANYING are photographs of a special scale-testing car recently completed for the U. S. Bureau of Standards by the Pennsylvania Railroad at its shops in Altoona, Pa. The car, which is No. 2, is similar in operation to No. 1, described in the Engineering Record of Oct. 25, 1913, page 460. Its purpose is to transport test weights and other apparatus necessary for determining the accuracy of scales. These weights are handled by means of a crane bridge, equipped with a trolley and hoist, which can be projected out of one end of the car. The general construction of the car is the same as that of the Pennsylvania Railroad standard X-25 box car, with minor changes to the superstructure, including end doors at the crane end, windows and a swinging side door, and the strengthening of the underframe by means of body bolsters, thereby raising the capacity to 140,000 lb. All machinery and interior equipment, such as generating plant, crane, weights and electric truck, were installed by A. H. Emery of Glenbrook, Conn.



ALL-STEEL SCALE-TESTING CAR BUILT FOR THE BUREAU OF STANDARDS BY THE PENNSYLVANIA RAILROAD

Why Appraisal Is Not Valuation

At Least Four Considerations Which Cannot in Any Wise Be Measured Have a Vital Bearing on the Value of a Public Utility

By GEORGE SYDNEY BINCKLEY
Consulting Engineer, Los Angeles

INSTRUCTION in the process of appraisal or valuation is not the purpose of this article. This subject—one of the most complex in its necessary detail with which the engineer has to deal—has formed the basis of some of the most thoughtful as well as many of the most wearisome papers that have been published within the last few years. Much as the subject has been discussed, however, certain fundamentals seem to have failed of recognition by most of those who have dealt with this problem in its many aspects. It often happens that the mere fact of too intimate proximity obscures rather than illuminates the broad principles involved in any problem, and it is not unlikely that the treatment of the subject of appraisal and valuation has suffered from this same cause. Leaving aside, then, the minutæ and even the broad principles of the processes involved in the laborious work of appraisal, it is the purpose of this article to outline or to emphasize only the fundamentals essential to equitable and well-balanced results.

One of the most striking weaknesses in the field of logic and applied mathematics is exhibited by the construction of an elaborate result by strict and formal methods, upon a substructure of assumption, doubt or actual error. In economics, ethics and philosophy this is so common that often two equally competent, methodical and conscientious students will arrive at opposite conclusions. Their method and process may be above question, but their basic assumptions are widely different. So also it is in engineering, for instance, where the problems of dam design are dealt with. Following basic assumptions of certain values, one man will, on purely theoretical grounds and by rigid mathematical processes, arrive at a result that satisfies him completely. Another, rejecting as uncertain or dangerous all but those elements whose values are known within rather narrow limits, proceeds by simple processes and with a generous regard for practical considerations to design a structure that his judgment tells him is safe. He is probably not quite so well satisfied with his result as his more highly theoretical brother, but his dam is generally the more trustworthy. The first is a mathematician's dam—the second an engineer's dam, as Sir Benjamin Baker so aptly put it.

RIGID PROCESSES ON DUBIOUS ASSUMPTIONS

The application of rigid and elaborate processes to the interpretation of clouded, doubtful or ill-balanced assumptions is certainly to be found, more often than not, perhaps, in the appraisal or valuation methods most in vogue at the present time. The task is not merely mathematical or actuarial, but to a far greater degree judicial, and fair and impartial judgment can only be founded upon a clear recognition of the fundamentals involved.

If the appraiser or valuer is to possess the true and undistorted mental perspective that is essential to even reasonable accuracy in the final adjustment, he must recognize, weigh and digest what the writer believes to be a fact of fundamental importance. This fact may be stated by saying that the work of appraisal of the present physical value of a property, based upon cost, deterioration and appreciation, is a problem preliminary to and wholly independent of the valuation of the property for purposes of sale or for fixing rates for service. This principle the writer believes to be of controlling importance. Its significance cannot be ignored. The problem of appraisal, complex as it is, should not for an instant be confused with the subsequent problem of valuation. What a thing has cost—what it would cost to duplicate in the physical sense—is by no means a measure of its value.

The problem of appraisal may be dealt with by fairly strict mathematical processes, tempered with a large proportion of common sense and individual judgment. The appraiser must be experienced through actual participation or long observation, in the class of business involved. His methods, when a definite basis exists, must be exact, strict and as simple as possible. Temperamentally, he should be of a fair, open and judicial mind, for it must be remembered that he must weigh and interpret those very general data upon which the element of depreciation or appreciation must be decided.

FOUR QUESTIONS FOLLOWING APPRAISAL

But when the complex work of appraisal of present physical value is completed—when the original cost or recorded capital expenditure is scaled down by consideration of deterioration or increased by betterments or appreciation in the value of real estate—an entirely separate task begins. Knowing as accurately as determinable the present physical value of the property in terms of capital account as affected by deterioration or appreciation, a set of problems must now be dealt with whose values are incommensurable with those already determined, although frequently of controlling importance in the final result. The valuer will be faced with certain questions profoundly affecting his conclusions, although incapable of expression in numerical terms. For instance, some few of the typical questions may be considered:

First.—Is the property as developed or capable of being developed, a natural monopoly?

Second.—Was there great hazard of loss involved in the investment required for the development of the property and bringing it to a paying basis?

Third.—Have the past profits of the enterprise been meager, moderate or very great?

Fourth.—Is the property as a whole or to an important degree likely to become obsolete within a short time?

NATURAL MONOPOLIES

As one of the fundamental questions to be considered by the valuer, take the first of those propounded above: Is the property a natural monopoly?

Take for example a small city—a mining town for instance—having but one source of potable water, which is owned by the water company. This water is valuable in proportion to its scarcity and the demand for it. Assume that the initial cost of the development was low, and that the cost of extension was easily met from the profits, so that the original investment is small relative to the income-producing power of the property. Here we have a natural monopoly. The slender stream of water is natural wealth as truly as the ore in the mines. The fortunate owner of the only water supply available can hardly be expected to regard as just a limitation of say 6 per cent on his actual investment, when the great value and importance of his property to the community is considered. The owner of a valuable mine is fortunate in his investment. The owner of the water supply which makes the operation of the mine possible must also be considered as fortunate, and to deprive him of the natural fruits of his foresight and good fortune is not just. Hence the valuer must recognize the unusual natural value of this property in deciding its proper earning power or its value for purposes of sale.

Let us now consider the second question: Was there great hazard of loss involved in the investment?

In this case, we may consider an irrigation project, in which lands, arid and remote but believed capable of development for the production of citrus fruits, are supplied with water from a distant source through a costly conduit. This is representative of a condition by no means unusual. With great faith in the lands to be irrigated, and believing that the proposed water supply is adequate, men may be assumed to have invested a large sum, only to find in the end that but a small part of the water supply anticipated is actually to be depended upon. The irrigable area is restricted, and the investment proves to be very heavy in comparison with the results attained. It is plain that in this case a natural limitation exists in the crop-producing value of the water. If too high water rates are charged, farming cannot be profitably carried on and the income will be curtailed. On the other hand, unless rates representing about "all the traffic will bear" are in force, there will have resulted the development of an important productive area, with permanent profit to its inhabitants and the State, at the uncompensated expense of the investors in the water system.

Here the question of actual loss must be considered. It may be wholly impossible to fix rates that allow of profitable farming operations and yet give even a very moderate return on the actual investment. In such a case, justice demands that the rates be left as high as commercially possible, and a certain loss must be endured by the investors. But suppose that the project was successful, although attended by great hazard of loss. Assume the development of lands that, if found suitable for citrus crops would be very valuable, but that, if found unsuitable for such crops, would be unable to bear the water rates necessary for even a fair return on the investment. This is a condition not at all unusual in its essentials. Here we have a successful operation, but one of a hazardous character. Is it proper to limit the earning power of this hazardous but eventually successful investment to the same amount that would be proper in a development involving no considerable risk?

BIG RISKS DEMAND HIGHER RETURNS

It is perfectly plain that if insisted upon this will effectually block the development of any public service project involving hazard of loss. It is idle to expect an investor to make a risky investment when he can secure the same return upon one that is safe and conservative. It must not be forgotten that many of the most valuable and successful enterprises that are now serving the public were attended with great hazard, and, rising among the wrecks of many failures, represent the most monumental courage, faith and foresight on the part of the investors. The importance of a policy under which this class of investment is encouraged is not to be underestimated, especially in a country of such undeveloped resources as our own.

So it must be admitted that the element of hazard must enter into the consideration of proper returns upon an investment. But it is also true that for purposes of sale this element cannot enter except in so far as it is properly recognized as a factor in its earning power. It is thus seen that while in the case of a hazard which has resulted in partial loss of the capital invested as high a rate as possible is justified, a valuation for purposes of sale could only allow an amount consistent with the actual earning power of the investment.

PAST PROFITS

The third question—that involving the history of the profits realized by the enterprise—is important for the purposes of both rate fixing and sale valuation. If the property happens to be a natural monopoly, this importance is relatively much less, yet the character of past profits must in some sense guide the valuer, as an increase in rates is always difficult to accomplish even where considerations of equity demand it, and on this account alone an otherwise valuable property may have to suffer in sale value. If not a natural monopoly, resentment at even properly increased rates may induce ruinous competition, and here again the value of the property may be impaired or even destroyed. The income-producing power of a property as well as its sale value is thus seen to be inevitably affected by its past record as to profits.

POSSIBLE OBSOLESCENCE

The last of the four questions—that relating to obsolescence—is one that must be considered in the light of natural limitations and contemporary progress in the arts involved. A high-class steam power plant for the generation of electric current may represent a large investment, may have suffered but little deterioration, and may be of high efficiency in its class. Yet its complete obsolescence may be threatened by an undeveloped water power near by.

This is a case of hazardous investment, made in response to the needs of the community served—a condition that must be recognized and considered in fixing rates so as to reduce this hazard as far as possible, and, pending final obsolescence, provide adequate compensation from the public who have benefited by the production and distribution of power. The same reasons that justify higher rates make inevitable a lower valuation for purposes of sale. The hazard that properly increases its rate of earning pending obsolescence just as properly discounts its value for sale purposes. It might properly yield 10 per cent on its present physical value, yet not be worth 50 per cent as a sale price.

APPRAISAL AND VALUATION

The fact that must not be lost sight of is the fundamental difference between the appraisal of present physical value based upon cost, deterioration and appreciation, and valuation for the purposes of rate fixing or sale of the property. These two aspects of the problem are too often hopelessly entangled, while in fact they are impossible of logical consideration in the same terms.

Although they may with advantage be combined in one person, the functions of the appraiser and the valuer are very different. The engineer who makes the appraisal of present physical value may or may not be qualified by temperament, mental caliber and experience in large affairs to deal with the questions involved in the final valuation. The man who takes before him the data of appraisal, and weighs them with or against other factors in their nature incapable of precise determination, must be by temperament, training and propensity capable of dealing in a spirit of strict and judicial impartiality with problems quite impossible of methodical solution.

In the foregoing the writer has dealt with the so-called "intangible values" as elements to be considered aside from those of a purely physical character. Among these "intangible values" is often included a nebulous sort of asset called "going concern." If this is taken to represent the amount of the actual deficit during the early period of the development of the enterprise, or the difference between a fair rate of interest on a conservative investment and the lower rate actually realized during this early period, then this amount may properly be credited to capital account. But if this, in definite terms, can be done, this is no longer an "intangible value" at all. On the other hand, if it cannot be shown that such a deficit actually existed, but that, on the contrary the enterprise suffered no such period of preliminary expense, then the mere fact that such a condition *might* have had to be faced is no reason for any allowance on capital account.

Strictly speaking, no value can be "intangible" yet definite in its amount. In other words, so soon as a value takes on a character that may be definitely expressed in figures, it is no longer intangible at all. For instance, suppose that the present physical value of a water system is $100,000, yet, on account of the low cost of operation, large water sales and conditions of natural monopoly it yields profits of 50 per cent on present physical value. Here we have a value far in excess of its purely physical aspect based on cost. Yet the value is by no means intangible, as it means a large earning power, capable of being expressed in terms of capital on any assumed percentage basis. But if this company is operating under a franchise, this may be admitted to be of importance in its earning power without being tangible, in the sense of being determinable as representing a definite capital value. To be sure, if this franchise cost a certain amount of money, this amount simply can be credited to capital account, but its *value* may be, and quite generally is, a very different matter, and cannot be expressed in definite terms. Hence while its *cost* is tangible, its *value* is not.

A franchise may indeed be costly even though a necessary evil—a liability, instead of an asset. In a recent case coming under the writer's observation the appraiser was much inclined to place a high money value on the franchise under which the company operated, because this franchise paid a very heavy tax. Hence, he reasoned, if it was taxable property, its value must be proportional to the tax levied. Now as a matter of fact this franchise was a mere permit to do business, conferred no exclusive privileges, and to the extent of the franchise tax paid was a burden and a liability instead of a valuable asset.

FUNCTIONS OF APPRAISER AND VALUER

The man or commission upon whom the duty of valuation falls has to deal in many, if not most cases, far more with questions of equity and justice than with those questions of determinable fact dealt with by the appraiser of physical values. The functions of the appraiser of physical values are judicial only as related to the questions of deterioration, betterments or changed values of real property. The functions of the valuer as distinct from those of the appraiser are of a judicial, rather than a technical character; it is for him to see broadly the equities, and to weigh and adjust those equities to the ends of impartial justice. Both functions may, with advantage, be combined in one man, but even here the two phases of the work should be rigidly separated. The first phase is the collection of evidence and the determination of facts. The second phase involves the digestion of the facts, the weighing of the evidence and the formation of a mature judgment. The first phase calls for a man of technical knowledge, familiar with the business considered, and of a fair and judicial mind. The second calls for one possessing not alone technical knowledge and mental qualities of a high order, but a wide and impartial vision—a man of large affairs. It is only such a man who can say that it is or is not good business to buy a property at a certain price, or at what price it is good business to buy it. And it is only from such a source that a proper judgment can be expected when the fair return upon an investment is in question. In the large affairs of private business this is the type of man always demanded. In public affairs the ends of equity and justice demand quite as high if not higher qualifications, for here, through its legal powers, the community holds the whip hand.

Whatever the ultimate rearrangement of our economic system may be, we must keep in mind the fact that we are living under an established and conventional scheme of property rights, and individual fads and futurist ideas of universal justice can have no proper place in the mind of the valuer of public utilities. His is a function of business judgment, expressed in accordance with our present scheme of property rights. His decisions must balance with present standards of business practice and business morality—not with abstract ideals of what these standards should be.

CONCLUSION

It will be observed that in the foregoing the writer has touched not at all upon methods. Important, even vital to final accuracy as processes may be, they are not fundamentals. But the recognition of the fact that hazardous investments will not be made without the prospect of large returns is a fundamental. The fact that a high order of ability, courage and initiative not alone must, but should, be paid for, is a fundamental. And until the socialistic theory of economics is swallowed hide and hoofs, the fact that some people have the good fortune to acquire property of great value at small cost, must also be a fundamental consideration.

There is a tendency at the present time that leans to the penalization of large success. This is one of the most damaging and mischievous of the many manifestations of a certain careless socialistic trend of the public mind, and the results of this error are already evident in a sharp decline—in some States a total stagnation—in the development of new public-service projects. The public, which has countenanced by its indifference at least a policy which in many cases borders on oppression, will inevitably suffer serious inconvenience or even actual hardship through the enforcement of conditions which render investment in a public-service project palpably unwise.

Unfortunately neither excess of zeal nor incompetence can excuse abuse of the great powers that have been conferred upon officers or commissions entrusted with problems of valuation or rate-making. And it is safe to say that such abuse will discourage investment in the business affected to a degree that no reasonable natural hazard could. The prompt recognition of this fact by the public is hardly to be hoped for, yet until this is done, little further development of public-service projects by private capital can be expected.

Diagram Facilitates Estimating Weight of Steel in Concrete

By ALBERT M. WOLF
Melrose Park, Illinois

THE DIAGRAM shown herewith will be found useful in making approximate estimates of the amount of reinforcing steel required for reinforced-concrete work when the yardage of concrete has been estimated and the percentage of reinforcing steel is known.

Two different horizontal scales are used, and two lines are plotted on the diagram; the intersections of the horizontal percentage lines with the first give weight of steel in pounds per cubic foot, and intersections with the second give weight of steel in pounds per cubic yard for the percentage of steel in question. Thus, if 1 per cent of steel is to be used we find from the diagram that 4.9 lb. of steel will be required per cubic foot of concrete and 132 lb. per cubic yard.

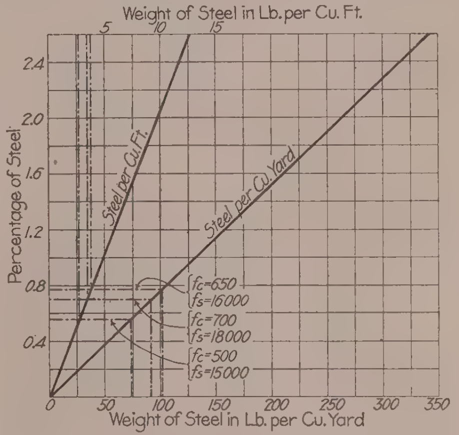


DIAGRAM FOR ESTIMATING WEIGHT OF STEEL IN CONCRETE

Sometimes on preliminary plans very little or no reinforcing will be shown, but the unit stresses will be given. In this case an estimate of the reinforcing steel can be made by using the percentage of steel which corresponds to the given unit stresses in steel and concrete. The percentages for the most commonly used unit stresses have been plotted on the diagram in dotted lines. The vertical lines from the intersection of these lines with the curves give the weights of steel per cubic foot and per cubic yard on the upper and lower horizontal scales.

In this connection it is interesting to note the considerable difference in the amounts of steel required for different unit stresses. Thus we see that for f_c = compressive stress in concrete = 650 lb. per square inch, and f_s = tensile unit stress in steel = 16,000 lb. per square inch, 102 lb. of steel are required per cubic yard, while for f_c = 500 lb. and f_s = 15,000 lb., only 74 lb. of steel are required.

It should be borne in mind that this diagram is made up for rectangular beams and theoretical percentages of reinforcement on tension side only, and does not make any allowance for laps of bars at splices, spacing bars, stirrups, etc., which are necessary in the detailed design. Just how much should be allowed for these details depends largely upon the class of work involved, and cannot be provided for on the diagram. An allowance of 10 per cent is, in general, enough to care for these details, but in any case the estimator should use his best judgment in this regard.

St. Paul Electrification Progressing Rapidly

First Locomotive Delivered for Main-Line Service Over Rockies—Overhead Construction Completed for 200 Miles

CONSTRUCTION work on the electrification of the Chicago, Milwaukee & St. Paul Railway over the Rocky Mountains has been actively prosecuted since the initial order for equipment was placed with the General Electric Company in September, 1914. The overhead construction, which will embrace 650 miles of single track, has been completed for 200 miles, and the 100,000-volt transmission line parallel to the tracks has been completed for a like distance, together with tie-in lines from the 100,000-volt system of the Montana Power Company. The trackage now ready for train operation includes extensive yards and sidings at Three Forks, Deer Lodge and Piedmont, and passing tracks at other points. The first of the forty-two electric locomotives has been delivered to the railway at Chicago.

One of the illustrations shows the general appearance of the new type of trolley construction and transmission lines. Wood-pole construction is used throughout both for cross-span and bracket construction. The twin 4/0 trolley wires are suspended individually and separately from the same steel catenary and the hangers of one trolley wire are located at points mid-span on the other. In the switching yards only one trolley wire is used.

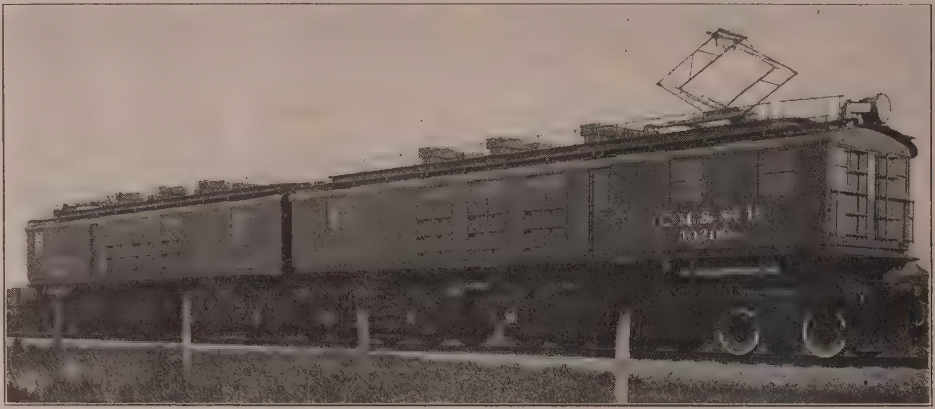
SUBSTATIONS

Seven substations designed to supply power to the first half of the 440 miles of route have been completed and electrical equipment is being rapidly installed. Complete shipments of transformers, motor-generator sets, switchboards and other accessories have been made for the stations first erected, and the equipment of four substations is practically ready for operation. Construction crews are proceeding with the erection of the remaining seven substations between Deer Lodge, Mont., and Avery, Idaho.

Each of the motor-generator sets consists of a 60-cycle, three-phase, 2300-volt synchronous motor direct-connected to two 1500-volt direct-current generators. The generators are connected permanently in series to supply 3000 volts to the trolley. Each set is also provided with an exciter at each end, one providing excitation for the revolving field of the motor and the other supplying the separately excited fields of the direct-current machines.

These sets are in general similar to the five 1000-kw., 2400-volt units in operation on the Butte, Anaconda & Pacific Railway except as regards voltage and capacity. One new feature, however, has been added. This consists of a longitudinal ventilation of the core and field coils similar to that employed in the GE ventilated railway motor. The use of this method of cooling has effected a considerable reduction in the floor space required per kilowatt.

The motor-generator sets are designed to operate inverted in case the regenerated power exceeds that required by other trains operating near-by. For this reason there is no necessity for water boxes or other energy-consuming devices, since the excess energy is transmitted to the 100,000-volt system.

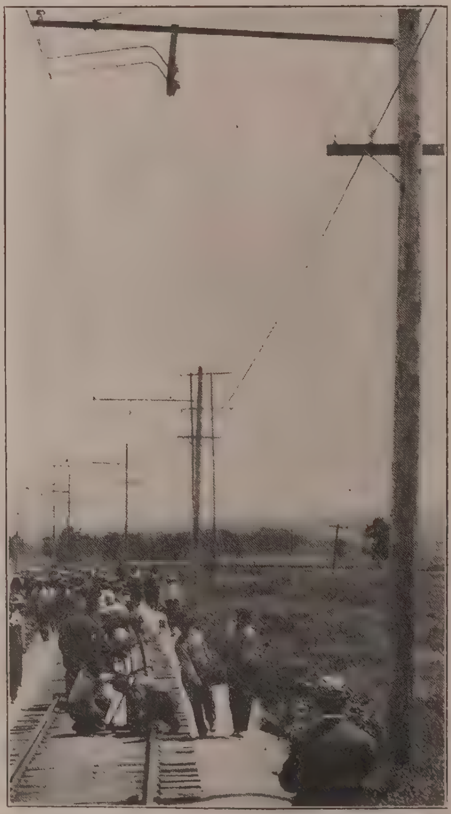


FREIGHT LOCOMOTIVE FOR ST. PAUL ELECTRIFICATION—WEIGHT 282 TONS

TRANSFORMERS

The transformers are under construction in the Pittsfield works of the General Electric Company. There are a total of thirty-two of these units, which are to be used for stepping down the power supply from the 100,000-volt transmission line to 2300 volts as required for the synchronous motor-generator sets. These transformers will be installed in fourteen substations, which will furnish power for the entire electrification from Harlowton, Mont., to Avery, Idaho. There are twenty-three 2500-kva. and nine 1900-kva. units.

In addition to the main transformer equipment, each substation will be furnished with a standard 10-kw., three-phase transformer stepping down from 2300 to 110 volts for lighting and auxiliary power circuits. For operating the railway signal circuits a standard 25-kw., single-phase transformer is being installed in each substation stepping up from 2300 to 4400 volts.



TYPICAL OVERHEAD CONSTRUCTION

LOCOMOTIVES

Work on the construction of the forty-two 282-ton locomotives is progressing rapidly at the Erie Works of the General Electric Company and in the Schenectady plant of the American Locomotive Company. The first complete locomotive was placed on the test tracks early in September and shipment was made Sept. 25 as scheduled. This locomotive has been taken in charge by the railway company at Chicago and is now being exhibited at various points on the Chicago, Milwaukee & St. Paul system under the direction of C. A. Goodnow, assistant to the president. A complete set of tests indicates that the locomotive will easily exceed the expectations of the designers.

The actual weights of the completed freight unit are as follows:

	Lb.
Total weight	564,000
Weight on drivers	448,000
Weight per driving axle	56,000
Weight per guiding axle	29,000

Twelve of the locomotives on order are geared for passenger service and the remaining thirty are geared for freight service. Both freight and passenger types are equipped for regenerative braking, this apparatus being under the control of the engineer. All of the passenger locomotives and several of the freight locomotives will be equipped with oil-fired steam boilers for heating the passenger trains. This equipment will include ample storage tanks for oil and water.

GROSS OPERATING REVENUES FOR JULY on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1,130 per mile, showing an increase of $3 or 0.3 per cent as compared with July, 1914. Operating expenses, were $750, a decrease of $36 or 4.6 per cent. Net operating revenue, therefore, was $380—an increase of $39 or 11.5 per cent, and operating income was $330—an increase of $39 or 13.3 per cent. The operating ratio was 66.3 per cent, as compared with 69.7 per cent in July, 1914, and 70.6 in July, 1913. Considering the three main districts, the respective ratios for July, 1915, and July, 1914, were as follows: Eastern, 65.5 and 70.8; Southern, 71.4 and 75.1; Western, 65.5 and 66.7.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Micaceous Rock Requires Careful Watching

Sir: Under the caption, "Rock slide causes second collapse of subway decking," and the subhead, "Concealed cracks cause slide," in your issue of Oct. 2 it appears that the slipping or sliding of the layers of micaceous shift on each other was the primary cause of the recent accident in the New York subway. As some trying experiences have been had recently with rock structure of this kind in preparing the foundations for two large dams for the additional water supply of Hartford, Conn., it may not be out of place at this time to state some of the causes and remedies.

The material accounted for the most part was a thinly foliated mica schist impregnated to a slight extent with quartz and feldspar, and containing veins, dikes and irregularly-disposed masses of quartz and pegmatite. After some exposure to the air many seams showed that had not at first appeared, while others that seemed tight opened up, and the rock layer had to be removed to get a satisfactory foundation. Several well-defined joint planes crossed the formation through which water was given access to the depths of the rock. This water, acting on certain components of the rock, produced layers of hydrated mica having many of the characteristics of graphite. In other cases the joint planes and seams were tightly filled with very finely divided clay. When first uncovered, these materials were firm and the rock had every appearance of solidity, the seams being quite tight. After brief exposure to the air the characteristics were completely changed. Both the hydrated mica and clay became so unguentous that, had opportunity occurred, there would undoubtedly have been considerable rock sliding.

Such conditions are readily detected on the side of a cutting having the ends of the strata exposed, but on the other side the treacherous seams are hidden by apparently firm rock layers. The realization of the conditions and care and patience in searching out and applying remedies at length produced what were considered proper conditions for a foundation. In general, but tempered by experience previously acquired, very extensive use was made of air and water jets to try out the strata. By this same means seams too small to excavate were blown or washed out and the whole mass was tightened up by grouting. Without question the methods here used could also in many cases be applied for the prevention of disastrous rock slides. It is probable that considerable expense could be saved in the rock trenches by a careful study of rock conditions both for preventing unnecessary excavations and for rendering more stable the foundations of heavy buildings in the vicinity of rock cuts.

Caleb Mills Saville,
Chief Engineer, Board of Water Commissioners.
Hartford, Conn.

[It will be remembered by those who read the description referred to and noted the photographs of this slide reproduced therewith that the break was vertical, and the rock mass had dropped off rather than slid. It should be pointed out that the general practice in New York subway work is to underpin all buildings in advance of any excavation.—Editor.]

Signs for Road Detours

Sir: In compliance with a suggestion contained in an editorial in the Engineering Record of July 24 I wish to advise you that this department has ordered detour signs erected, as shown on the accompanying photograph. Whenever a road is to be closed for construction or for bridge repairs by the County Highways Department there has been ordered to be placed such signs, leading traffic from the point barricaded back to the same road beyond the barricade.

DETOUR SIGN, COOK COUNTY, ILLINOIS

George A. Quinlan,
Superintendent of Highways.
Chicago.

Can Sheet-Pile Cut-Off Be Driven in Core of Old Earth Dam?

Sir: Will any of your readers kindly inform me if they know of any case in which interlocking steel piling has been used for repairing a fracture in the puddle core of a high earthwork dam? Such a fracture, due to the erosion of leakage water, has occurred in a dam about 65 ft. high, and it is under consideration to drive a row of piling along the center line of the puddle core for a width of 50 ft., and to a depth of 90 ft. Under such circumstances the questions arise as to whether the piling might be expected to go down vertically, whether it would reach the required depth before becoming earthfast, and whether the shocks of the steam pile hammer would be likely to injure the puddle core.

E. P. Hill.
London.

[Whether the shocks of the pile hammer would be likely to injure the puddle core in question would probably depend on the size of the core and the material of which it is made. It does not seem likely, however, that a puddle core of any size would be injured in any way by driving piling into it. It has been found difficult to keep piling vertical in driving it to penetrations much less than 90 ft. unless a rigid driver and proper guide blocks are used. It is not likely that the cut-off would be a success if any boulders happened to be in the ground below the core. Round piling has been driven to as great or greater depths with the help of jets, and there does not seem to be any reason why sheet piling could not be so driven. If any of our readers have had experience in the use of sheet piling under similar conditions, the Engineering Record will gladly give space to their answers to the questions contained in the above letter. —Editor.]

What Is Ultimate Strength of Black Annealed Iron Wire?

Sir: The writer would like to know if you or any of your readers can cite him to references giving up-to-date and reliable data on the ultimate strength of black annealed iron wire, such as is generally used in concrete form work. I am especially interested in the probable ultimate strength of ties formed by twisting two or more strands of wire together as is customary on wall form work.

I have written one large manufacturer of wire, and also to the U. S. Bureau of Standards, but neither is able to give me any information along this line. What data I have been able to find vary considerably, and some of them have proved misleading in my own practice.

Engineer.

Inland Water Transportation

Sir: In an editorial in the Engineering Record of Sept. 11, you invite a discussion of an abstract of a paper by Capt. John H. Bernhard on inland water transportation, published on page 332 of that issue. The comments offered by the writer will be confined to the lower Mississippi River problem.

The author of the paper very properly places great emphasis upon the fatal handicap to river traffic imposed by the lack of terminal facilities, with the truly just observation that "with the present river terminals, the height of inefficiency seems to have been reached." He states, also, that "the excessive terminal cost often offsets the advantage of the low river rate."

The first and obvious remedy proposed by the author is to supply these lacking terminals; but that is easier said than done. The author's proposed device of providing floating terminals might in some measure meet the requirements, but can hardly be regarded as other than a makeshift, as permanent elevator structures on the banks of the river are what is needed. But here crops out a fundamental difficulty. You cannot have permanent structures on a river with unstable banks. It is not sufficient that the structure itself be on a permanent site; it is equally important that navigable water be maintained to give access to the structure.

Two notable cases may be cited showing the futility of building costly elevators on permanent sites and not maintaining means of access to them. In the early seventies of last century the Anchor Line Steamboat Company of St. Louis erected a large elevator in Memphis and a similar one in Vicksburg. These elevators very successfully handled a great volume of miscellaneous freight of all kinds. After a few years of such useful service both elevators were rendered wholly inaccessible to steamboats by channel changes created by caving banks several miles distant from their sites, by which the channel in front of the elevators was in both cases completely filled by mud deposits, and the buildings fell into decay or were torn down.

If the problem of the lower Mississippi River had fallen into competent engineering hands when in its pristine state, before any attempt had been made by human agency to control its destructive flood effects, the problem presented would have been, on its positive side, how to get out of the Mississippi River the greatest possible uses for man's needs; and, on the other hand, to prevent the invasion of the adjacent territory by devastating floods.

In the contemplation of such a problem the first and obvious thing to be accomplished would have been to give permanence to the shore lines and fixation to the line of flood flow. This must have presented itself as the fundamental basis and condition precedent to any further developments. But when the first individual settlers located themselves along the lower river they obeyed the natural impulse to throw up small levees along the river banks to keep the overflow off their lands. Settlements multiplied and the levee lines were extended until, in the course of years, levee building developed into regular systems, and levees came to dominate all activities toward river control, the levee structures continually growing in magnitude, cost and importance.

For a century past a continual and costly warfare has been carried on between levee building on the one hand and levee destruction by caving banks on the other. Of the many millions of dollars that have been expended in this warfare it is probable that three-fourths at least of the money has been ingulfed by the river. Viewing the case solely from a levee standpoint, experience has abundantly shown that a system of flood protection, consisting of a conjunction of levee building and caving banks, is self-limiting and largely abortive.

Appropriations for the Mississippi River by the Federal Government have been made mainly in response to appeals for the building of levees made by riparian owners, to whose eyes the importance of bank protection has been obscured by the more imminent necessity to them of interposing levees between their property and the floods.

It is gratifying to note that during the past two or three years there has been a growing realization of the importance of bank protection, which, it is hoped, shall develop into a popular demand that specific provision shall be made in appropriation bills for this branch of river work, which provision has never been made heretofore. To those authorities who deprecate efforts to further improve the channel of the Mississippi River on the ground that it has now greater capacity for navigation than is being utilized, let the following picture be presented: Let us postulate a river channel from Cairo to the Gulf of Mexico with a least depth of low water of 25 ft., ranging up to 75 ft. at maximum flood stages. Let us assume stable shore lines upon which have been erected all proper facilities for handling freight, and permanent levee lines between which the whole flood flow is confined. Let us proceed down the river from Cairo to its mouth at midstage on a vessel drawing 30 ft., and its bow pointing to the head of the Panama Canal 1400 miles across the Gulf.

Can it be supposed that such a channel, reaching from the Gulf coast over a thousand miles northward into the heart of a region of high industrial development, would not be teeming with busy traffic? And supposing that such a channel has been created in the main trunk of the river up to Cairo; would such development halt there, or would not rather this main trunk become the stem from which would grow a similar full development of navigation in all its branching tributaries?

The remaining vital question is: Can this achievement be realized, and how? Given permanent shore lines and fixation of the line of flood flow, the necessary work would be practically accomplished and any auxiliary work needed would follow without doubt.

The writer has assumed a dogmatic tone that may seem to savor of ignorance or arrogance, or both, made necessary by the brevity of treatment of so large a subject; but these expressions are well matured convictions, based upon long study, reflection and observation upon the most important river problem that presents itself to American engineers. T. G. Dabney.

Clarksdale, Miss.

Sir: In your issue of Sept. 11, page 332, you devote considerable space to an abstract of a discussion by Captain Bernhard intended to show the desirability of larger expenditures by the National Government for the construction and development of waterways. This seems to be based on two fallacies which, in the writer's opinion, vitiate the whole argument—one, which was long ago exploded, that the cost of inland water transportation is only the cost of operating the vehicles (vessels, barges or whatever they may be), and the other, that because some commodities are transported by railroads at less than the average rate for the whole country, therefore, any lower rates represent a loss to the transportation company, which has to be made up out of higher rates between non-competitive points.

No theory of establishing "rates" can be entirely satisfactory to everyone, but a considerable experience with other systems based on zones, distance, etc., has shown to the satisfaction of the writer that they have at least as many objections, even though of a different kind, as the theory of basing them on "what the traffic can bear," or, as it is better expressed, "the rate which will move the traffic."

There can be no question of the cheapness of transportation on natural waterways, but even then the cost of trucking at each end may nullify the advantages when compared with railway transportation, which brings the freight directly to the factory siding. Water transportation might be cheaper for transfer between ocean-going steamers and inland points reached by natural waterways, but these are very few and a very small proportion when compared with the thousands of factories with railway sidings on the property which brings them in touch with every foot of the country and also with most docks and ocean terminals.

A very fair example of the arguments of those who favor the expenditure of Government money for artificial waterways is the complaint of the lack of care in keeping the Mississippi River channels marked. It is possible, of course, but highly improbable, that the cost of doing this is charged against the river traffic; if not, why not ask the National Government at the expense of the general public to install, operate and maintain efficient signaling systems on the railways and guarantee everybody immunity from accident?

It would seem to be of interest to ask Captain Bernhard to capitalize the expenditures to date on the Mississippi River and its tributaries, add the annual interest charges to the traffic, and then tell us what the cost of transportation might be, even making all allowances for protection of adjacent lands from floods and assuming a volume of traffic which might move at such rates as would be possible on this basis. This has been done for the Erie Canal and we know that is hopelessly outclassed as a transportation machine, though Captain Bernhard apparently does not consider the cost of construction as an item worth considering, or one which should be paid for by the traffic. Fred Lavis,

Consulting Engineer.

New York City.

Filing Engineering Clippings

Sir: Possibly the following method of filing clippings on engineering subjects may be of interest to young engineers who find that bound volumes require too much space.

Procure a box of envelopes and with each one upside down write in both (now upper) corners of the front side the same number, numbering the separate ones consecutively. Place the clippings one in each envelope. Turn the flaps in over the clippings, which will prevent their falling out.

For the file use twenty-six looseleaf notebook leaves, binding them together with paper fasteners. Devote one page to each letter in the alphabet.

The advantage in using the loose leaves is that as soon as a page is filled it can be removed and another substituted for it containing the same subjects rearranged in alphabetical order.

Read each article thoroughly and index the main subject and all minor subjects. By minor the writer means cost data on forms or labor, methods of erection, or special designs, etc. Each of these should be indexed under the proper letter, and on the right-hand side of the page write the number of the envelope in which the article may be found. Thus by referring to the index the number of the envelope containing the article that includes the desired information can be instantly obtained.

Henry A. Burr,

Railway Draftsman and Designer, Nashville, Chattanooga & St. Louis Railway.

Nashville, Tenn.

The Effect of Preservatives on the strength of timber is reported by H. S. Betts and J. A. Newlin in Bulletin 286, U. S. Department of Agriculture, in which results of bending tests on bridge stringers, both untreated and treated by commercial creosoting methods, are given. Loblolly pine, longleaf pine and Douglas fir of ordinary stock sizes (8 x 16 in.) were used, and supplementary tests on small clear pieces cut from the specimens were made. The deductions are: That timber may be very materially weakened by preservation processes, although creosote in itself does not appear to weaken it; that a process which may seriously injure one timber may not affect another, and that the same treatment may have a different effect upon different pieces, depending on form, size and condition when treated.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

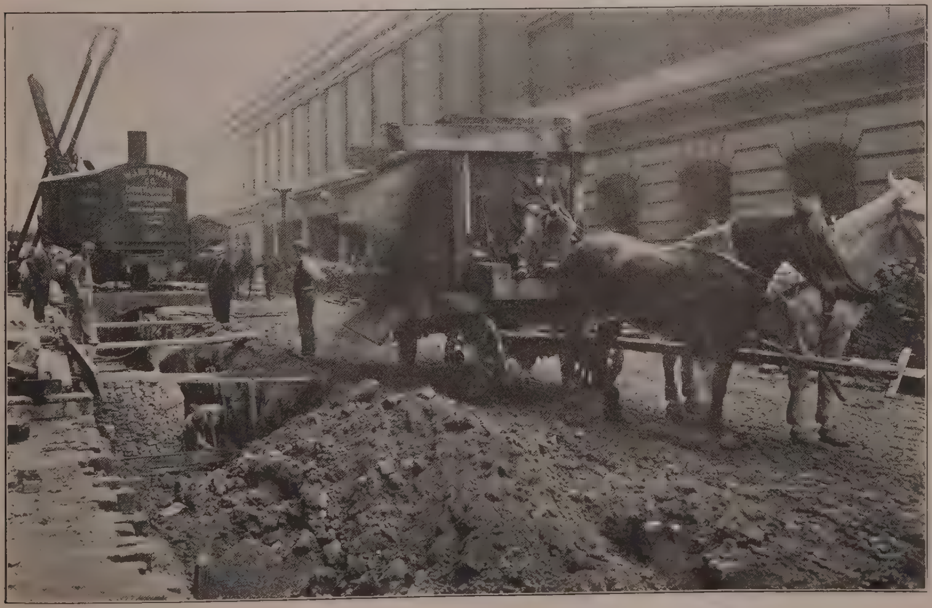
[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Backfilling Wagons, Truck and Shovel Make Record on Sewer Job

BY mounting triangular 3-yd. boxes on two ordinary wagon bodies and utilizing a 6-yd. motor truck, a Chicago contractor was able to complete 2½ blocks of 5½-ft. brick sewer in five days and to keep the street clean while the work was being done. The following notes are taken from the *Excavating Engineer:* The top of the box is 10 ft. above ground and the floor forms a chute starting at the top on the outside and extending at a 45-deg. angle past the side of the wagon for a distance of about 3 ft. This overhang is sufficient to permit discharging the material into the trench and still keep the wheels of the wagon from crumbling the edge of the trench. The discharge gate consists of a door, hinged at the top, controlled by a lever beside the driver's seat.

The sewer is part of the readjustment made necessary by reason of the new Union Station. It is a 5½-ft. circular brick sewer 2½ blocks long on Canal Street alongside the Chicago & North Western Railway station. The first half block was excavated in tunnel by hand on account of railroad tracks. The remainder was excavated by a revolving shovel with a ⅝-yd. dipper on a dipper handle 30 ft. long. The trench was from 14 to 20 ft. deep and 7½ ft. wide. The tough blue clay with occasional boulders required little bracing. The average advance was from 60 to 85 ft. per 10-hr. day. The shovel worked on a set of six 3 x 24-ft. platforms straddling the trench. The platforms consisted of two 12 x 12-in. timbers armored on the inside by a ¼-in. plate. These timbers were separated by a 14-ft. 12 x 12-in. stick with the center cut away for the insertion of steel straps, on which was hung a ring for handling.

In addition to the shovel crew, there were four men in the trench shaping the forms, handling braces and assisting in moving the platform forward. Two men tamped the backfill. The two brick layers were assisted by three passers and one man carrying mortar. With this crew the work was completed between Aug. 2 and 12, five days being lost on account of rain. The W. J. Newman Company was the contractor.

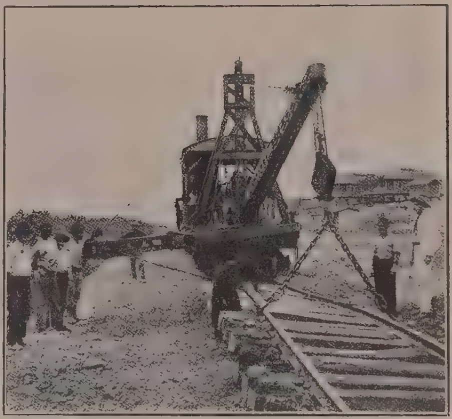


PILING DIRT ON STREETS AND REHANDLING AVOIDED BY USING THESE WAGONS

Machine Built at Panama Canal Shifts Track on Dumps

THE main dumps for disposing of excavated material on the Panama Canal were started from trestles constructed for the purpose, and when filled out as far as the spreader would reach the track was shifted to one of the edges of the dump. The track-shifter illustrated herewith was devised on the Isthmus for this work and was described in a paper presented to the International Engineering Congress in San Francisco last month by Maj.-Gen. George W. Goethals, governor of the Canal Zone.

The track-shifter consisted of a boom, with suitable tackle, extending from a flatcar out over the track in advance of the car, which lifted the track bodily, ties and all, from its bed. Another boom, lying in a practically horizontal position, and also equipped with tackle, extended out at an angle to the side of the car, and was used for pulling the track to one side or another. For operating the booms, the car was equipped with an engine similar to the ordinary hoisting engine. At first the track-shifter only moved a section of track 5 ft. sideways at a time, but it was later improved so that the track could be thrown over 9 ft. at one operation. On one occasion, at the Tabernilla dump, 1¼ miles of track were shifted 12 ft. from the original position in 1 hr. and 50 min. Ten of these machines were made on the Isthmus and used on the work. To facilitate this track shifting, the track had one free end and was made more flexible by an occasional switch-point in laying the rails.



SHIFTS TRACK 9 FEET AT A TIME

Railroad Mixing Plant Has Bins on Mixer Car Fed by Crane

By M. B. UHRICH

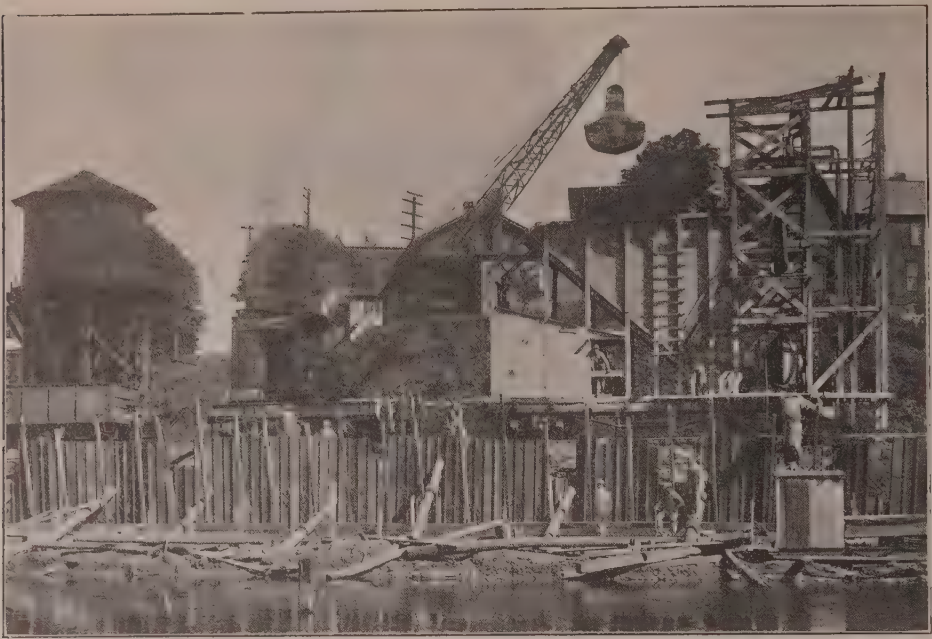
Assistant Engineer, Erie Railroad, Jamestown, N. Y.

THE UNUSUAL mixing plant illustrated herewith is proving itself very efficient and profitable in the construction of the heavy concrete retaining walls and bridge abutments necessary for the work of separating the grades of the Erie Railroad Company from those of three of the busiest streets in the city of Jamestown, N. Y.

This work, being done by Mahoney & Swanson, a local firm, has been in progress since the spring of 1913, and although the amount of concrete in place to date seems small, the actual time of mixing and placing is very little. Considerable trouble was met with in the beginning owing to the subsurface conditions. After the cofferdams were completed and the foundations prepared the mixing and placing went quite rapidly.

The whole plant consists of two Brownhoist locomotive cranes, two electric pumps and a Foote mixer placed on a flat car, which is equipped with an elevating tower and hoist and bins for the sand and broken stone. The locomotive cranes are mounted on standard-gage trucks, one having a 36-ft. and the other a 48-ft. boom. These machines, equipped with a steam-hammer and clam-shell buckets, drive and draw all the sheet piling and do all the excavating. The one with the longer boom forms the link between the loaded cars of material and the mixing plant.

This mixing plant was designed by Mr. Swanson of the firm and detailed and built by the Foote Manufacturing Company. An elevating tower is attached to the front end of the car, which allows the bucket to be lowered to the floor level. It is 38 ft. high from the rail and elevates the concrete 35 ft. Next to this and on the end of the car floor is a three-sack-batch mixer which discharges over the end of the car into the



TOWER BUILT BEYOND END OF CAR ALLOWS BUCKET TO DROP LEVEL WITH FLOOR

elevator bucket. The charging bucket on the other side of the mixer is partitioned, each of the two compartments having iron cleats riveted to the sides, by means of which the stone and sand are measured. On the other end of the car is a two-drum hoist, which operates the feed bucket and elevator. Both the mixer and the hoist are driven by electricity.

Between these two machines and supported on a heavy framework is a V-shaped bin which holds about a carload of material. This is equipped with an adjustable partition to meet the requirements of different mixtures. This bin discharges directly into the feed bucket, and is as low as possible to allow clearance enough for the bucket to be raised and lowered. Its top extends the full length of the car. The material is dropped into this bin by the crane. Deflectors placed on the top of the bin avoid spilling and waste.

The mixer is set in on a track opposite the foundations or forms to be filled by the locomotive crane, which operates directly behind it. In the rear and within reach of the crane is a car of sand. On an adjacent track and opposite the mixer is the box car containing the cement, and in the rear of this is a car of stone. The crane easily unloads the sand and stone into the bin faster than they are used, and does its own switching, removing the empty cars and bringing up full ones without delaying the work. This leaves only the cement to be moved by hand, which is easily done, using a platform from the mixing car to the cement car.

This scheme requires two tracks for operation, but it occasionally happens that only one is available. There is more switching to be done then, of course, as the crane has only one car of material within reach. The cement car is placed at the nearest convenient point and unloaded on platforms which are carried to the mixer by the crane as it switches the other materials. Little or no time is lost in this operation, depending on the distance to the switching tracks.

The usual force necessary to operate this plant is one engineer and one fireman on the crane, one man on the mixer, one man on the hoist, two men on the binds and three men handling the cement.

This mixing plant has a maximum capacity of 20 yd. an hour, and when two tracks are in use, reaches an efficiency of 98.6 per cent. When only one track is available the efficiency varies from 92 to 66 per cent, averaging 84 per cent for the past season.

How Powder Fuse May Be Lighted Without Splitting

BY HOLDING a safety match against the powder core at the end of the fuse and drawing the match box across the match, causing the match and powder core to inflame immediately, a black powder time fuse may be lighted more readily than by splitting, according to the United States Bureau of Mines. This way of lighting a fuse was originated by W. C. Cope, of the explosives chemical laboratory of the bureau in Pittsburgh, and is the result of considerable experience in blasting operations. It is obvious that this method may be used only when but one piece of fuse is to be lighted, as where several charges are to be fired at once the time interval between the ignitions would be too long. The method, however, would be applicable to mud-capping and block-holding on construction work.

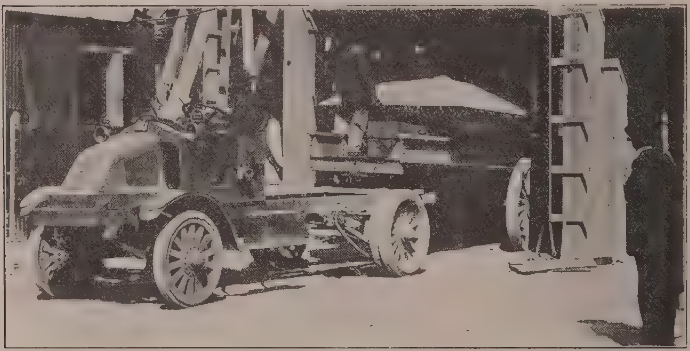
In case safety matches are not at hand, the ordinary household match may be used by placing one match against the powder core and then lighting another and quickly touching it to the first one. Either way is said to produce better results than the old method of splitting the end of the fuse.

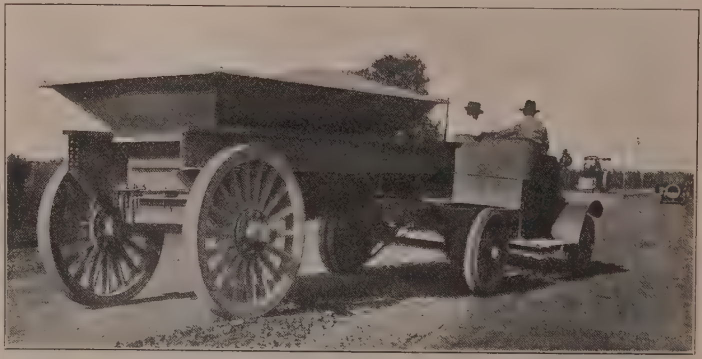
Standard Motor Truck and Trailer Operated as a Unit

THAT THE contractor is fast coming to realize, under certain conditions, the value of the motor truck as a method of haul and with his usual perspicacity is not slow in adapting it to his needs when aided by the manufacturer is evidenced in the accompanying photographs.

By removing the regular body of their motor truck and fastening a Martin fifth wheel to the rear frame of the chassis, a Kansas City company combined a $3\frac{1}{2}$-ton Kelly-Springfield motor truck and a 5-cu. yd. Bulldog dump wagon as one unit without destroying the individuality of the motor truck. The dump wagon weighs 5000 lb. and with 5 cu. yd. of stone the total trailing load is about 12,500 lb.

At the conclusion of this particular use of the truck its regular body was replaced and the machine was ready for other service.





THIS AUTOMOBILE TRUCK AND WAGON WERE CONVERTED INTO A TRAILER UNIT FOR SPECIAL SERVICE

The accompanying photographs show the combination which enabled the W. M. Spencer Crushed Rock Company to make four 20-mile trips, or 80 miles per day, delivering 20 cu. yd. of crushed rock. The 20-mile trips averaged $2\frac{1}{2}$ hr., which included loading and unloading the trailer. About 20 gal. of gasoline and from $\frac{1}{2}$ to $\frac{3}{4}$ qt. of oil was used per day. The roads over which the runs were made were in good condition and only a small fraction were of the ordinary dirt type. However, grades as high as 5 per cent had to be climbed.

A trip of approximately 50 miles was made from Kansas City to Independence, Mo., and return in 5 hr. 50 min., loading the wagon with $5\frac{1}{4}$ cu. yd. of crushed rock and ten 100-lb. sacks of cement, the latter being placed on top.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Seek to Compel Water Company to Install Filtration Plant

Efforts are being made to force a compromise between the East Chicago & Indiana Harbor Water Company, the cities involved and the Indiana State Board of Health in the controversy in which the board of health seeks to compel the company to install a filter system. The board allowed the question to go over until its next meeting, probably some time in November, pending an attempt of Mayor Frank Callahan of Indiana Harbor to arrive at an understanding with the officials of the water company on the filtration problem. Under the laws of Indiana the State Board of Health has power to order the installation of such a filtration system and officials of the board said that unless the Mayor and the company settled the matter it would probably enter an order in the case.

American Society Recommends Co-operative Plans for Investigtaions

At the regular meeting of the American Society of Civil Engineers Oct. 20, in New York City, F. zur Nedden presented a paper on "Induced Currents of Fluids." Secretary Hunt read written contributions from Dr. C. G. P. DeLaval and Clemens Herschel, and John C. Trautwine, Jr., discussed the paper. After the closing remarks by Mr. Nedden, suggesting the need of more co-operation in the conduct of experiments, Mr. Trautwine offered a resolution recommending that the Board of Directors take the necessary steps to promote, through the U. S. Bureau of Standards and the Engineering Foundation, a systematic plan of co-operative tests which would prevent duplication and waste.

A. S. M. I. Adopts Patented Paving Specifications After Strenuous Debate

Four-Day Convention at Dayton Enlivened by Discussion on Fifty Papers and Reports—Pioneer Activated Sludge Plant at Milwaukee Described

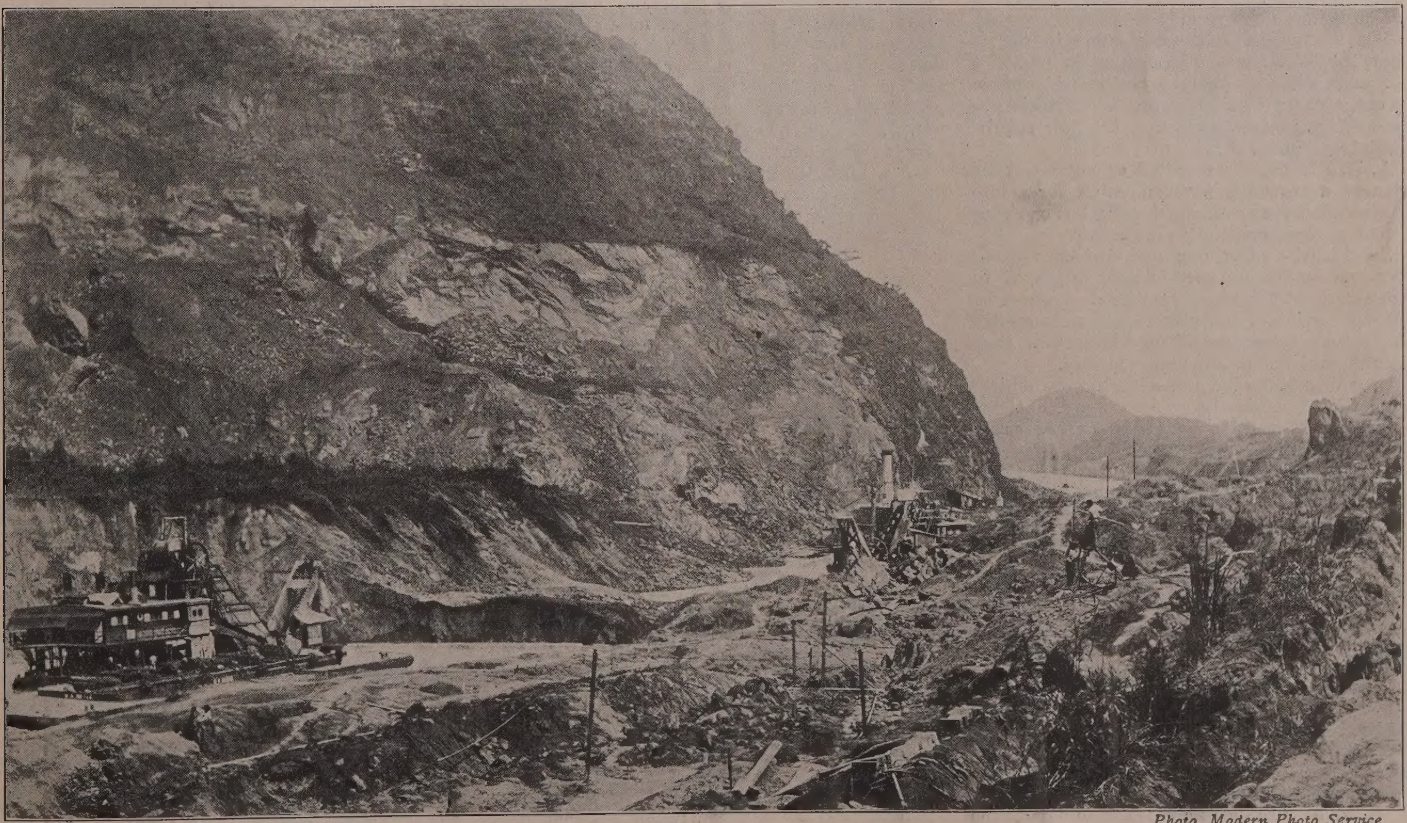
The adoption of standard specifications for bituminous pavements proved to be the storm center of the Dayton convention of the American Society of Municipal Improvements, Oct. 12, 13, 14 and 15. After battling with the convention the greater part of an afternoon session until 7 p. m. and holding fifty-one active members to a final vote of 32 to 19, the majority report of the sub-committee went down to defeat with colors still flying. As adopted the minority report sets forth as standards of the society specifications for Bitulithic pavement under the Warren Brothers patents and for a pavement similar to one laid under the so-called Topeka specifications which the Warren Brothers concede will not infringe. Opinions differed as to whether a pavement with the mixtures proposed will or will not be as good as the Topeka pavement. Among the fifty reports and papers there was important action taken in revising, defining and co-ordinating the duties of the standing committees. T. Chalkley Hatton's paper on "The Pioneer Plant for Treating Sewage by the Activated Sludge Process," abstract of which appeared on page 48 of the Engineering Record of Oct. 16, marked the first presentation of details of this installation.

Revise Wood Block Specifications

Numerous changes in the specifications on wood block proposed last year were made following four papers on various mooted questions on wood block by J. W. Howard, P. C. Reilly, Hermann von Schrenk and E. R. Dutton.

This specification, according to the predictions of those familiar with the general situation, was to have been the sensation of the convention, but because of the alleged "closed" preserving oil clauses it was finally put over to another year with the request that the incoming committee furnish for the printed proceedings additional clauses for oils not coming within the range of those specified. To the casual delegate Hermann von Schrenk's paper, containing numerous examples of old pavements in which various kinds of oil had been effective as a preservative for many years, largely removed the quality of the oil as the criterion of the success or failure of wood block paving and centered interest on the details of treatment and methods of laying. Another telling argument for internal harmony of the warring wood block interests was the statement of Eugene W. Stern, chief engineer of the Bureau of Highways, Borough of Manhattan, New York City, to the effect that no wood block paving was being laid in the Borough of Manhattan in 1915 because of strenuous objections by 250 representative street users to certain characteristics of wood block, which Mr. Stern believed could be much improved. Whether or not the closed specification advocates (if there are such) saw defeat awaiting them, the fact remains that the decision as to specifications for oil are now entrusted to the engineer and all producers

Latest Slide at Panama Which Has Closed Canal to Traffic for an Indefinite Period



Photo, Modern Photo Service

A LENGTH OF 1300 FEET IS INVOLVED, AND FOR PART OF THE DISTANCE, AS THIS VIEW SHOWS, THE CHANNEL IS PRACTICALLY CLOSED

Engineers Responsible for Construction of Panama-Pacific

Left to Right—L. F. Laurey, assistant electrical and mechanical engineer of the Exposition staff; H. D. Dewell, chief structural engineer; Shirley Baker, assistant director of works; Harris D. H. Connick, director of works; C. S. Scott; William H. Crocker, chairman of committee on buildings and grounds; Theodore tion; John A. Brashear; Prof. C. D. Marx; J. J. Carty; C. C. Vogelsang, commissioned of the Exposition; F. L. Hutchinson; Calvin W. Rice; Lieut.-Commander

have a competing chance. Some of the changes in the specification finally submitted as information widen the wood clauses to admit some of the Cuban pines, reduce the specific gravity of the oil at 38 deg. C. to a value of from 1.06 to 1.12, define the steaming and vacuum treatment more closely to insure penetration of the sapwood, insist on wetting before laying, advocate laying on a 1-in. 1:3 mortar bed or on sand containing 10 to 25 per cent of clay, laying closely instead of loosely and filling joints with sand or bitumen.

Other Paving Standards Little Changed

Brick paving specifications were not materially changed. They now permit the use of wire-cut lug brick. Suggestions were made to investigate vertical fibre brick. Before the sub-committee the National Paving Brick Manufacturers' Association strongly advocated the adoption of the standards recently adopted by the American Society for Testing Materials, but no action was taken.

Minor changes only were made in the asphalt specifications. The clauses in regard to contours after 5 years were considered too severe. Instead of requiring no deviation beyond ⅜ in. in 4-ft. distances, the new requirement is ½ in. in 3 ft.

A. H. Blanchard presented as a guide rather than as a standard a specification for a bituminous concrete pavement having but one product of a stone crushing plant.

Specifications for one and two-course concrete pavement followed closely those of the American Concrete Institute. However, clauses for joints and reinforcing were omitted and simply referred to in a footnote as items for the engineer to determine locally.

Crushing tests for stone block were omitted and the French test for wear inserted. Opinions differed as to the value of gravel in pinning the blocks together. It was contended that the difficulty in getting the filler to the bottom more than offset the pinning advantage.

Dr. Rudolph Hering presented two changes in the sewer pipe specification. The first omits the details of joints for reinforced concrete pipe and the second adds the words "without collapse" in the clause relating to tests on reinforced concrete pipe.

Garbage Disposal

J. E. Barlow, director of public service, Dayton, described conditions in his city since Jan. 1, when burying of the material began, using workhouse men. He also told of a new 50-ton plant in the course of construction.

Valuable data were presented on operation of the Atlanta high temperature destructor by E. R. Conant, chief engineer.

The report of the committee on garbage and street cleaning, John T. Fetherston, chairman, indicated a rapidly growing tendency toward the use of motor trucks for both purposes.

Introspective Investigation

The introspective report of the committee on committees, of which A. P. Folwell was chairman, recommended dividing the subject of streets—surface, sub-surface and supersurface—among additional committees, inasmuch as paving proper seems to have usurped the attention of the present committee. The six heads suggested and accepted by the convention are street paving, sidewalks and street design, city planning, parks and parkways, street lighting, traffic and transportation.

Society Affairs

Charles C. Brown, secretary, reported an active membership of 339, 100 having been lost during the year and 43 new members obtained. Receipts for the year total $2,972.45 and expenditures were $3,349.60, the deficit being drawn from the surplus funds.

The next convention will be held in Newark, N. J., under the following newly elected officers: President, A. F. Macallum; vice-presidents, N. S. Sprague, J. B. Hittell and E. R. Conant; secretary, C. C. Brown, Indianapolis; treasurer, W. B. Howe.

Indiana Ruling Frees Owner From Liability for Material Bills

Judge Rochford of the Marion County (Ind.) Superior Court held in a case recently decided that the owner of a building, which is erected, cannot be held responsible for the payment of material bills contracted for by the individual who is under contract with the owner to pay all material bills. The remedy of the seller of material for which a contractor does not pay is to sue the contractor, and not to file a lien against the building into which the material has been put, the Court held.

Judgments have been given often in Indiana in favor of the seller of materials against the owners of property in which materials used were not paid for by the contractor. Judge Rochford, however, held that when a building is being erected under contract and the contractor fails to pay his material bills, the only action that can lie is against the contractor. The decision was made in the case in which S. S. Rhodes & Son sued Grace Selvage, Joseph W. Selvage, C. C. Wynn, contractor, and others for a judgment of $700 for material put into two houses being built by Wynn for Selvage. Judge Rochford said the testimony disclosed that Wynn was under contract to build the houses and he held that the Selvages could not be held responsible. A judgment was given the plaintiff against Wynn. Judge Rochford contends that his ruling is supported by a decision from the Appellate Court of Indiana, handed down March 2, of this year. Mechanic lien suits for labor, however, Judge Rochford held, are good against the owner of a building on which the labor is put, when the contractor fails to pay such services.

Publicity Brings Enforcement of Chicago Building Code

That publicity pays is shown in the following notice sent all Chicago architects and builders by Charles Bostrom, city commissioner of buildings: "You are hereby notified that all buildings must comply with Section 520 (c) of the Revised Building Ordinances, which reads as follows: In buildings of every class where wood furring is used on brick walls, the brick between joists shall be projected from the bottom of the joist to the top of the joist for the full thickness of the furring and in no case shall such projection be less than 2 in.

"As such projection is intended for a fire stop, it must be solidly built to the full depth of the joist, with both vertical and horizontal joints properly filled with mortar. You are further notified that failure to comply with said ordinance will mean a loss of time and additional expense, for the reason that work on building will be stopped and cannot be resumed until satisfactory assurance is given that walls will be built as required."

To the *American Lumberman* full credit is due for bringing to light a flagrant violation of the Chicago Building Code. See editorial in the Engineering Record of Oct. 9, page 437.

Bloomington to Pay for New Water Supply by Installments

Hampered by the fact that it is very close to its bonded debt limit the city of Bloomington, Ind., has been unable to construct the pipe line necessary to connect its water distribution system to the dam recently built at Leonard Springs, about 7 miles distant from the city. To overcome this difficulty an arrangement has been entered into whereby four banks in the city are to furnish money for a holding company to let contracts for the necessary piping, which will amount to from $75,000 to $100,000. This plant will be rented to the city in such a manner that 10 per cent of the

Exposition and Success of International Engineering Congress

chief of construction;. W. O. Waters, superintendent of building construction; Guy L. Bayley, chief electrical and mechanical engineer; A. H. Markwart,
Hardee; Charles C. Moore, president of Exposition; John A. Britton, vice-president of Exposition; Carl S. Herman; Dr. F. J. V. Skiff, director in chief of Exposi-
C. H. Woodward, U. S. N.; Charles Warren Hunt and Howard H. Holmes, consulting engineer of Exposition

total cost will be returned each year with interest at 6 per cent. At the expiration of 10 years the city will come into possession of the entire property. The details of agreement will have to be ratified by the State public service commission before becoming effective.

Governor Signs Contract for Boston's $3,000,000 Drydock

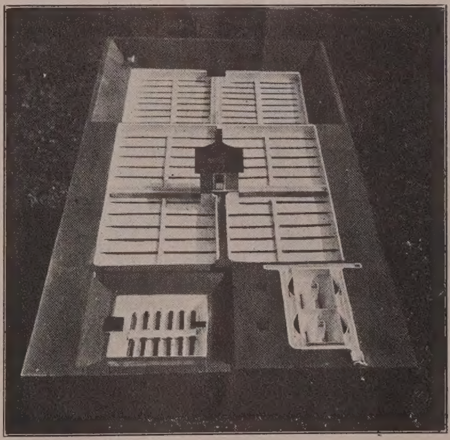
Construction of the $3,000,000 1200-ft. drydock at Boston has at last been made possible, Governor Walsh having on Oct. 13 signed the contract for the work. The low bid of the Holbrook. Cabot & Rollins Corporation was approved by the directors of the Port of Boston more than a year ago, but the matter has since been pending, owing to political and labor complications.

Development in California Under Commission Jurisdiction

The Railroad Commission of California has recently published a report outlining the public utility development work carried on in that State since the commission assumed jurisdiction over stocks and bonds, a period of approximately three and one-half years from March, 1912, to September, 1915. During this period stocks, bonds, notes and certificates have been authorized by the commission amounting to $466,000,000, the report states. Of this amount $175,000,000 has been authorized for the payment of maturing debts; $248,000,000 has been authorized for new construction, additional development of existing utilities and new ventures, and the balance has been used for miscellaneous purposes. The authority for new improvements has been distributed in the report as follows: Steam railroads (including $25,000,000 for expenditures outside of California), $102,800,000; electric railroads, $32,500,000; gas and electric companies, $80,000,000; water companies, $18,500,000; telephone and telegraph companies, $2,500,000; warehouses, $1,600,000; pipe lines, $10,000,000. Approximately $200,000,000 of the foregoing has already been expended or is in the process of expenditure. During the 3½-year period under review there have been launched 16 new railroad enterprises, 13 new gas and electric companies, 6 new telephone companies, a new $5,000,000 oil pipe line, an independent ferry line on San Francisco Bay and many new water companies. Seven hundred miles of new railway lines have been constructed or are now being constructed under authority of the commission and water power projects, involving the development of a total of 100,000 hp. have been initiated.

Miniature Sewage Plant Feature of Dayton's Budget Exhibit

A miniature sewage disposal plant on a scale of ¼ in. to 1 ft. with precise automatic siphons working at the correct cycle period, was one of the features of the municipal budget exhibit at Dayton, Ohio, last week. Charles H. Kline, a member of the engineering staff, years ago, before he became an engineer, learned the tinners' trade and was therefore able to cut the model out of tin, working nights, in about two weeks' time. The Imhoff tanks with their suspended flowing-through chambers, involving conic sections, and all other parts went together without difficulty. The model, which is 3 ft. 2 in. wide by 7 ft. long, is a replica of the 800,000-gal. plant at Urbana, Ohio, except as to inner workings, such as valves, siphons, pipes and tiling, which had to be re-designed on account of their small size to overcome capillary attraction.



THIS MINIATURE ACTUALLY WORKED ON CORRECT CYCLE PERIODS

Other exhibits of interest to the engineer were a papier-maché model of the river improvements; waterworks apparatus, particularly meters and leaking fixtures; a full size sewage system with manholes, catch basins, inlets connected by a vitrified pipe system being cleaned and a 9-ft. segmental tile outfall sewer; clogged inlets, and a section of reinforced concrete pipe; tree roots taken from sewers; paving models of all kinds; laboratory testing outfits; garbage details; street cleaning apparatus and numerous charts. Although the exhibit is primarily one to educate Dayton's citizens and to assist in carrying a $1,000,000 bond issue, it was opportunely open to the delegates of the American Society of Municipal Improvements, who were also interested in the exhibit of the centralized purchasing department.

American Association of Engineers Prepares for Convention

Plans for the national convention of the American Association of Engineers to be held in Chicago, Dec. 10 and 11, are being rapidly completed. All engineering societies have been invited to send official representatives to the convention to join in the discussions and assist in attempts to solve a few of the welfare problems confronting the engineer.

During the latter half of September a gain of 55 members was made. A national membership committee has been selected to push the organization of local chapters in various parts of the United States. Those appointed on the committee are A. H. Krom, assistant engineer, Illinois State Public Utilities Commission; F. H. Newell, professor of civil engineering University of Illinois; S. Steenerson, engineer, Minnesota Highway Commission; Edwin R. Webster, civil engineer, Marion, Iowa; Daniel B. Luten, bridge engineer, Indianapolis; O. L. Dent, referee of drainage matters, Bemidji, Minn.; R. A. West, civil engineer, Tye River, Va.; Israel L. Beerman, engineer, New York State Highway Commission, Fillmore, N. Y.; Harold Almert, consulting engineer, Chicago; W. N. Winter, electrical engineer, Hood River, Ore.; H. L. Holderman, civil engineer, C., M. & St. P. Ry., Lewiston, Mont.; Hunter McDonald, chief engineer, N. C. & St. L. Ry., Nashville, Tenn.; George C. Keech, electrical engineer, Chicago, and A. T. North, contracting engineer, Chicago.

Owing to the increase in its activities, the association has taken larger quarters at 29 S. La Salle Street, Chicago.

Supervision of the work of the qualification committee has been undertaken by Ernest McCullough, consulting engineer, Chicago. The Service Clearing House is actively engaged in putting the engineer in touch with the employer and the employer in touch with the man without charge. One of the largest electrical manufacturing concerns in the United States has given the association the preference in filling all vacancies which require men of technical training.

News of Engineering Societies

The Municipal Engineers of the City of New York will hold a meeting at the Engineering Societies Building, Oct. 28. William Goldsmith will present a paper on "One Year's Operation — Manhattan Municipal Asphalt Plant."

The Albany Society of Civil Engineers will hear John H. Gregory of the firm of Hering & Gregory, consulting engineers, of New York City, speak on "Sewage Disposal with Special Reference to Present Day Practice," at a meeting to be held in that city Oct. 26.

Personal Notes

Arthur C. Everham, formerly assistant chief engineer of the Kansas City Terminal Railway, has been appointed engineer of construction for the Kansas City Bridge Company, engineers and builders of bridges, viaducts, turntables, shuttles, buildings and substructures, of Kansas City. Mr. Everham was graduated from the University of Cincinnati in 1902 and was connected with the Cleveland, Chicago, Cincinnati & St. Louis Railway, on maintenance and construction, until 1903, when he entered the service of the Michigan Central Railroad as assistant engineer. In 1905 he was appointed assistant engineer in charge of all preliminary and location plans and surveys for the Detroit River tunnels for that company. As assistant tunnel engineer he had charge of the construction of the tunnels and of the general plans and specifications for the construction of the terminal facilities at both ends, from 1907 to 1909. He was appointed assistant chief engineer of the Kansas City Terminal Railway Company in 1910 and continued in that office until April of the present year. In his new connection he will have charge in the field of the construction work handled by the bridge company, devoting his time particularly to Government and railroad construction.

John T. Whitney has been appointed to a position on the forces of the H. Koppers Company of Pittsburgh, on work in connection with the construction of the new coke ovens for the La Belle Iron Works at Steubenville, Ohio.

F. R. Lyons, formerly civil engineer student in the U. S. Office of Public Roads and Rural Engineering, has been promoted to the grade of U. S. junior highway engineer and transferred from the U. S. Post Road work in MacDowel County, North Carolina, to the Russel Experimental Road in Alexandria County, Virginia.

W. E. Guignon, formerly division engineer on the Pennsylvania Lines West of Pittsburgh, at Zanesville, Ohio, has been transferred to the position of division engineer at Logansport, Ind., succeeding A. C. Watson, whose transfer to another division is noted elsewhere in these columns.

G. Preston Brady, formerly connected with Campbell & Lattimore, contractors on the foundation work for the High Level Bridge at St. Catharines, Ont., is now engaged in drafting work for the Pere Marquette Railroad in connection with valuation work.

J. K. Sherman, formerly assistant division engineer of the Pennsylvania Lines West of Pittsburgh, at Pittsburgh, has been appointed division engineer at Zanesville, Ohio, succeeding W. E. Guignon, whose transfer to another post is noted elsewhere in these columns.

J. B. Richards, formerly general superintendent for P. M. Johnston & Company of St. Elmo, Ill., on the construction of concrete roads in Illinois, is now in charge of construction for the H. H. Hall Construction Company of East St. Louis, Ill., on concrete bridge work at French Village, Ill.

A. C. Watson, division engineer of the Pennsylvania Lines West of Pittsburgh, at Logansport, Ind., has been transferred to a similar position at Cleveland, Ohio.

L. E. Faulkner, formerly division engineer of the Mississippi Central Railroad, at Hattiesburg, Miss., has been appointed chief engineer of that road.

W. W. Greenland, formerly assistant engineer of the Wabash Railroad, at Moberly, Mo., has been appointed engineer maintenance-of-way of the Western division of that road.

R. L. Carlinghouse, formerly connected with the Kern County (Cal.) Highway Commission, has been appointed to a position on the forces of the State highway department, in the office at Fresno.

Leroy N. Reeve, formerly office engineer for the U. S. Reclamation Service on the Grand Valley project in Colorado, has been transferred to the office at Denver as designing engineer.

H. E. Curtis, formerly draftsman for the Southern Power Company on the design of its Eno steam plant and, previous to that, assistant superintendent with the Foundation Company of New York City, has been appointed assistant engineer on the forces of the Michigan Limestone & Chemical Company of Rogers City, Mich.

A. H. Riney, U. S. junior engineer, has been transferred from the Osage River improvement work to the work on the Missouri River at Arrowrock, Mo. He has been succeeded in charge of the Osage River work by E. M. Levy, U. S. junior engineer.

Aberthaw Construction Company, specialist in reinforced concrete and industrial buildings, dams and water powers, of Boston, will move its main offices from 8 Beacon Street to the Niles Building at 27 School Street.

F. C. Dressendorfer, formerly assistant engineer on the forces of the Chicago & Northwestern Railway and, more recently, assistant superintendent for John Marsch, general contractor, has joined the organization of the Turner Construction Company of New York City. Mr. Dressendorfer first engaged in engineering work in 1904 on the forces of the Girard Construction Company of Cleveland and Chicago on railway location and construction. He entered the employ of the Chicago & Northwestern in 1905 and, in 1912, had charge of the Milwaukee improvements of that company, which included terminal construction, the erection of a reinforced concrete elevator and bridge and dock work. In 1914 he left the employ of the railway to accept a position as assistant superintendent in charge of bridge construction on the Grand Trunk extension in Massachusetts for John Marsch.

Frank W. Skinner, consulting engineer of New York City, has returned from a five months' business trip to London, Paris and Le Havre, where he secured from the Belgian Government orders for several hundred portable interlocking steel houses of his own design, to be manufactured in America. He also furnished the British Expeditionary Force with his "Slip-Joint" steel piles for protecting military trenches. Mr. Skinner was retained for important designing work, was consulting engineer in Paris to the Crown Prince of Serbia and was technical adviser to Gaston, Williams & Wigmore of New York, London, Paris, Rome and Petrograd.

George E. King, Jr., formerly draftsman for the Turners Falls Power & Electric Company of Turners Falls. Mass., has been appointed draftsman with the National Survey Company, maker and publisher of maps, of Chester, Vt.

S. V. Keeler, formerly draftsman with the Pennsylvania State Highway Department, has been appointed transitman on the forces of the Philadelphia & Reading Railway at Williamsport, Pa.

Clarence M. Lawson has been appointed State engineer in charge of railroad and public utility work in Wisconsin by J. G. D. Mack, State engineer. This is, in effect, a reappointment, as Mr. Lawson has been in charge of substantially the same line of work for several years, the only difference being that his office is now placed under the authority of the State engineer, the creation of whose office was authorized under a recent act of the Legislature.

C. C. Brown, editor of *Municipal Engineering*, has been appointed professor of sanitary engineering at Purdue University to succeed Professor Sackett, whose resignation was noted in these columns several months ago. Professor Brown was graduated from Cornell and Michigan Universities and has held the position of professor of civil engineering at Rose Polytechnic Institute and also at Union College. He has also held a number of important positions in the engineering field, including the posts of city engineer of Indianapolis and consulting engineer for the New York State Board of Health.

Walter E. Lee, formerly assistant water engineer of Baltimore, has been appointed water engineer of that city. He was graduated from Cornell University in 1909 and was engaged in railroad work until 1911, when he joined the engineering forces of Baltimore's water department.

Robert L. Clemmitt, who has been acting as water engineer of the city of Baltimore since the resignation of Ezra B. Whitman in 1914, returns to his former position as assistant water engineer, upon the appointment of Walter E. Lee as water engineer, which is noted elsewhere in these columns.

Obituary Notes

Augustus Jay Du Bois, professor of civil engineering, Sheffield Scientific School, died suddenly of heart failure at New Haven, Conn., on Oct. 29, at the age of sixty-six. He was the author of some of the best-known treatises on structural design in the English language, a member of various engineering and scientific societies and a member of the governing board of Sheffield Scientific School. He was graduated from that school with the class of 1869.

William Byrd King, formerly second vice-president and general manager of the Fort Worth Belt Railway, died in Fort Worth, Tex., Oct. 11. He was born in 1850 and entered railway service in 1869, as rodman on the engineering forces of the Orange & Alexander. After serving as assistant engineer with the Texas & Pacific, the Missouri, Kansas & Texas, the Fort Worth & Denver City and the Fort Worth & Rio Grande, he attained the office of chief engineer of the Fort Worth & Denver City in 1889. Two years later he was appointed chief engineer of the Fort Worth & Rio Grande. From this position he was advanced to the office of vice-president and general manager. He became vice-president and general manager of the Fort Worth Belt Railway in 1902, and resigned from that office about a year ago on account of poor health.

Civil Service Examination

Illinois.—It is announced that an examination for an assistant sanitary engineer, salary from $100 to $250 a month, is to be held in the near future. This position is in conjunction with the recently established sanitary engineering bureau of the Board of Health. It requires a man of 25 years of age who, among other qualifications, has had an engineering training at least two years' experience in sanitary work. The duties are subordinate to those of the chief sanitary engineer, and include, besides, bacteriological analyses and inspection work.